博 士 論 文

Observational Variables for Considering a Switch from a Normal to a Dysphagia Diet among Older Adults Requiring Long-Term Care: Cross-sectional study～ A One-Year Multicenter Longitudinal Study (長期介護を必要とする高齢者の常食から嚥下食への切り替えを検討するための観察変数:横断研究～1年間の多施設縦断研究)

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北海道大学
大学院歯学院口腔医学専攻

武　田　雅　彩

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ORIGINAL ARTICLE

Factors Associated with Food Form in Long-Term Care Insurance Facilities

Maaya Takeda[1] · Kazutaka Okada[1] · Miyako Kondo[1] · Kenshu Taira[1] · Yutaka Watanabe[1] · Kayoko Ito[2] · Junko Nakajima[3] · Yoshie Ozaki[4] · Rikimaru Sasaki[5] · Yasuhiro Nishi[6] · Junichi Furuya[7] · Kenichi Akino[8] · Hiromi Ohta[9] · Tomohisa Ohno[10] · Tsuyoshi Kodama[11] · Hideo Sakaguchi[12] · Tetsuo Hanagata[13] · Yuji Sato[7] · Mitsuyoshi Yoshida[14] · Yutaka Yamazaki[1]

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Abstract

We examined factors related to dietary intake status (food form) of long-term care facility (LTCF) residents to identify factors related to proper food form choice for older individuals requiring nursing care. We surveyed 888 residents from 37 LTCFs in Japan. We evaluated basic information (age, sex, body mass index [BMI]), food form (swallowing-adjusted diet class), Barthel Index (BI), Clinical Dementia Rating (CDR), simply evaluated eating and swallowing functions, the number of present/functional teeth, oral diadochokinesis, repetitive saliva swallowing test (RSST), and modified water swallowing test. To clarify factors associated with food form, participants who had good nutrition by oral intake were categorized into the dysphagic diet (DD) and normal diet (ND) groups. Multi-level analyses were used to detect oral functions associated with food form status. Among objective assessments, BMI (odds ratio [OR] 0.979, 95% confidence interval [CI] − 0.022- to 0.006, $p=0.001$), BI (OR 0.993, 95% CI − 0.007 to − 0.004, $p<0.001$), CDR 3.0 (OR 1.002, 95% CI 0.002−0.236, $p=0.046$), present teeth (OR 0.993, 95% CI − 0.007 to − 0.001, $p=0.011$), functional teeth (OR 0.989, 95% CI − 0.011 to − 0.005, $p<0.001$), and RSST (OR 0.960, 95% CI − 0.041 to − 0.007, $p=0.006$) were significantly associated with DD vs ND discrimination. Simple evaluations of coughing (OR 1.056, 0.054−0.198, $p=0.001$) and rinsing (OR 1.010, 0.010−0.174, $p=0.029$) could also discriminate food form status. These simple evaluations provide insight into the discrepancies between food form status and eating abilities of LTCF residents. Periodic evaluations by the nursing caregiver may help to prevent aspiration by older individuals with dysphagia.

Keywords Coughing · Dysphagic diets · Food form · Long-term care facility · Rinsing · Deglutition disorders

Introduction

It is anticipated that the number of older people with eating and swallowing dysfunction would increase in Japan, which is a super-aging society [1]. The prevalence of swallowing dysfunction has been reported to vary from 11.4% to 38.0% in community-dwelling elderly and from 40.0% to 68.0% in long-term care facilities (LTCFs) [2].

Providing adequate diet (food form) to older adults with eating and swallowing dysfunction may help prevent aspiration, asphyxia, and undernutrition [3–5]. However, in LTCFs lacking experts on dysphagia, caregivers may often not be able to determine rapidly whether an adequate food form was provided in cases where the eating and swallowing function of the residents declines. When a caregiver does not recognize that the eating and swallowing function of an LTCF resident has reduced in time, change to the appropriate food form may be delayed, thus, leading to an increased risk of aspiration, choking, and malnutrition. In cases of patients with diseases such as stroke and Parkinson's disease, such a reduced function is expected and is understandable, and the nursing caregiver should be typically aware of the possibility of eating and swallowing dysfunction. These residents also undergo medical follow-up examination by a clinician, and it is easy to respond quickly to eating and swallowing dysfunction [6]. However, when aging and disuse are the main causes of reduced eating and swallowing function, this

✉ Yutaka Watanabe
ywata@den.hokudai.ac.jp

Extended author information available on the last page of the article

reduction could not be easily noticed as the change is small [6].

Video fluorography and video endoscopy performed by experts on dysphagia are critical for assessing the eating and swallowing function and determining the appropriate food form [7, 8]. Nevertheless, they are difficult to implement frequently for people in all health institutions, nursing homes, and those living at home [9]. Thus, the eating and swallowing function of older individuals requiring care should be routinely observed by their nursing caregivers (nurses, those in the nursing professions, and, in some cases, their families) and not be impacted by the illness affecting these functions. Moreover, they should examine whether such function gradually decreases because of aging. This may facilitate detection of signs of mismatch between function and food form, and may allow prompt referral of such individuals to medical institutions specializing in eating and swallowing dysfunction to ensure the provision of an adequate food form. In cases where nurses, caregivers, families, and others can work together to assess eating and swallowing function and identify food form incompatibilities early, a timeous change to the appropriate food form may be facilitated, thus, reducing the risks of pneumonitis, undernutrition, asphyxia, and aspiration in older individuals with swallowing dysfunction. Consequently, home care may be continued when hospitalization treatment can be avoided, and medical expenditure and nursing care expenditure may also decrease.

We hypothesized that it would be possible for nursing caregivers to screen for cases of older individuals with difficulty in eating a normal diet (ND) in need of care and transition to a dysphagic diet (DD) using brief eating and swallowing function assessments that can be implemented on a daily basis.

To evaluate this hypothesis, we investigated the diet (food form) type provided to LTCF residents and examined brief eating and swallowing function assessments that could be performed by nursing caregivers on a daily basis. The main aim of this study was to identify the factors that could be considered when transitioning from an ND to DD. We also evaluated factors related to the discrimination between NDs and DDs in a cross-sectional study.

Materials and Methods

Study Design

This was a cross-sectional study of Japanese LTCF residents. The study was conducted with the approval of the Ethics Committee of the Japanese Society of Gerodontology (approval number: 2018-1) and the Ethics Committee of the Graduate School of Dentistry, Hokkaido University (approval number: 2020-4).

Participants

We first conducted a workshop for 30 members of the Special Committee of the Japanese Society of Gerodontology to explain the content of this study and unify the evaluation criteria for the contents of the survey. The members explained the content of this study to the director and staff of the LTCF institution at which they worked. In total, we collaborated with 37 LTCF facilities in 17 regions in Japan. In September 2018, we informed all residents and their families regarding the content of this study in writing; written informed consent was obtained from 888 residents and their families for participating in the study. Then, we conducted the survey from October 2018 to February 2019.

Survey Items

Before the survey, the research members provided training on the assessment of survey items to all nurses and administrative dietitians at the institution and standardized the evaluation criteria. Subsequently, we distributed a questionnaire and conducted the following survey regarding residents for whom the nurses and administrative dietitians in each facility were responsible.

Survey by Questionnaire

The following information was obtained in the survey: The administrative dietitian in charge of each participant transcribed the data concerning the age, sex, and body mass index (BMI) from the long-term care record. Other items, such as oral survey data, Barthel Index (BI), and Clinical Dementia Rating (CDR) were evaluated by the nurse in charge. The final decision on the CDR was made by a trained specialist.

Basic Information

Assessment of Life Function and Cognitive Function

A nurse in charge conducted a life-function assessment using the BI [10]. Cognitive function was assessed using the CDR, based on Morris's assessment methods [11]. A psychiatrist made the final determination of the CDR.

Oral Conditions

The nurse in charge performed an oral cavity investigation. The oral cavity investigation was explained in advance using a manual, and each nurse in charge tried to unify the standards. This survey included 12 items: language, drooling,

halitosis, masticatory movement, tongue movement, perioral muscle, left–right asymmetric movement of the mouth angle, swallowing, coughing, changes in voice quality after swallowing, respiratory observation after swallowing, and rinsing. These brief assessments were based on prior discussions with LTCF personnel regarding the assessments that could be used as a reference for dietary morphology and were summarized by the study members. In advance, we discussed the manual with nurses, and researchers assessed four to five participants together with the nurses to ensure standardized evaluations.

The language was evaluated on a three-point scale: 0, capable of speaking a language; 1, capable of speaking a language but with poor articulation; and 2, unable to speak a language. Zero was considered a good score, while 1 and 2 were considered poor scores.

Drooling was assessed as follows: 0, none; 1, occasional; and 2, constant drooling. A score of 0 indicated a good function, while scores of 1 and 2 indicated poor function. Halitosis was assessed as follows: 0, none; 1, slight halitosis; and 2, severe halitosis. A score of 0 indicated a good function, while scores of 1 and 2 indicated poor function. Masticatory movement was evaluated as follows: scores of 0, 1, and 2 corresponded to cases of chewing movement when food was put in the oral cavity, cases of chewing movement when prompted by the voice of another person, and cases of no chewing movement even prompted by another person, respectively. A score of 0 was considered good, while those of 1 and 2 were considered poor. Tongue mobility was also evaluated in three grades: 0, nearly complete mobility; 1, mobility within a small range; and 2, tongue immobility. A score of 0 was considered good, while those of 1 and 2 were considered poor. Perioral muscle movement was assessed in three grades: 0, mobility; 1, slightly difficult movement; and 2, immobility. A score of 0 was considered good, while those of 1 and 2 were considered poor. Left–right asymmetric movement of the mouth angle was assessed in two phases: 0, absent; 1, present. Similarly, swallowing was assessed in two grades: 0, possible, and 1, delayed.

Coughing was rated on a 2-point scale: 0 was defined as no coughing, while 1 was defined as coughing. Coughing or no coughing was judged in cases when the patient coughed or did not cough during the meal, respectively. Changes in voice quality after swallowing were assessed as follows: 0, absent; and 1, present. Respiratory observations after swallowing were assessed as follows: 0, no anomaly; and 1, shallower and faster respiration after swallowing. The ability to rinse their mouths was assessed as follows: 0, able; 1, incomplete; and 2, unable. A score of 0 was considered good, while those of 1 and 2 were considered poor. For rinsing, when water was put in the mouth, the cheeks should be moved to the extent that the leftover food left in the oral cavity could be removed. Moreover, the patient's ability to gargle was evaluated. For example, if a patient placed water in their mouth and expectorated without moving their cheeks, this was evaluated as an inability to rinse his/her mouth.

The oral residue after swallowing was classified at three levels as follows: 0, none; 1, small amount of residue; and 2, marked amount of residue. A score of 0 was considered good, while those of 1 and 2 were considered poor.

Total Energy Intake and Food Form

We used the Japanese Society for Feeding and Swallowing Rehabilitation classification code 2013 as the reference standard for the food form [12, 13]. To unify the contents of the survey, the members of the Special Committee of the Japanese Society of Gerodontology who participated in the workshop ate the actual meals of the facility in charge.

I have confirmed compliance with the aforementioned rehabilitation classification code. In addition, while constantly observing the diet, it was ensured that the patients ate the meal step by step, a safe form was selected, and the diet form was adjusted.

In addition, ND was judged to be a diet other than the four-stage dietary form belonging to the Swallowing Rehabilitation Classification Code 2013. The DD based on the Swallowing Rehabilitation classification code 2013 in this study was similar to the "minced & moist" or "soft & bite size" forms proposed by the International Dysphagia Diet Standardization Initiative (IDDSI).

Actual Survey

A survey was conducted by 30 dentists and dental hygienists who had been pre-trained in the use of uniform evaluation standards. The examined items were the following: number of remaining teeth, number of functional teeth, oral diadochokinesis (ODK) evaluation, the Modified Water Swallowing Test (MWST), and the Repetitive Saliva Swallowing Test (RSST).

Assessment of Oral Condition

The remaining teeth were considered the total number of teeth erupting into the oral cavity, excluding the roots with disintegrated crowns and the teeth affected by severe periodontitis. Functional teeth were considered the sum of the remaining and prosthetic teeth (e.g., implants, pontics, and dentures).

Objective Assessment of Oral Function

The oral function was assessed using the ODK evaluation, MWST, and RSST.

ODK

ODK tests comprehensively measure the sophistication of movements in the lips and tongue. As many pa//ta//ka/syllables as possible were repeatedly pronounced in 5 s, and the number of pronunciations of each syllable per second was measured using automated instrumentation (Healthy Mouth Smoking Handy, Takei Instrument Industry Co. Ltd., Niigata, Japan) [14].

MWST

The MWST [15] was performed in combination with the cervical auscultation technique [16]. According to the usual method, 3 mL of cold water was poured into the oral floor with a 5-mL syringe, and swallowing was indicated. Then, changes in swallowing and breath sounds, before and after swallowing, were evaluated with a stethoscope. They were classified as abnormal when the pharyngeal swallowing sounds were wet or in cases where bubbling sounds, wheezing, or coughing reflexes were present [16].

RSST

Swallowing function assessment was also performed using the RSST [17]. Each participant was instructed to repeat an empty swallow as many times as possible in 30 s while seated. The examiner placed the index and middle fingers on the participant's hyoid bone and laryngeal prominence and counted the number of times the hyoid bone crossed the fingers during the swallowing reflex.

Statistical Analysis

We first divided the participants into the parenteral ingestion and oral intake groups according to whether they had received parenteral nutrition or enteral nutrition, respectively. Next, the oral intake group was divided into the poor nutrition status (daily dietary intake < 75% of the number of meals provided by the administrative dietitians) and well-nourished groups (daily dietary intake ≥ 75% of the number of meals). In addition, the group with good nutrition intake status was divided into subgroups of patients consuming either DD or ND. The examined items were compared between the groups. Sex, oral context, and CDR were compared using the chi-square test. Continuous variables were first assessed for normal data distribution. This was followed by an unpaired *t* test for comparison of age and BMI, and the Mann–Whitney *U* test was performed for the BI, functional teeth, ODK, MWST, and RSST.

To investigate the factors associated with the food form of older individuals requiring long-term care, two levels of food form (ND or DD) were used as objective variables. BMI [3], BI [18], and CDR [5], which have previously been reported to be associated with age, sex, and dietary morphology, as well as the remaining teeth, functional teeth, ODK, RSST, and MWST, were used as explanatory variables in the objective assessment of the oral cavity.

Similarly, two levels of food form were used as the objective variables in the simplified assessment of the oral cavity, with age, sex, BMI, BI, CDR, remaining teeth, and functional teeth used as covariates. Similarly, language, drooling, halitosis, masticatory movement, tongue movement, perioral muscle, left–right asymmetric movement of the mouth angle, swallowing, coughing, changes in voice quality after swallowing, respiratory observation after swallowing, rinsing, and oral residue were used as explanatory variables. Moreover, the explanatory variables were divided into objective and simple evaluations, and a crude analysis was performed. All significant items from the crude analysis were included in a multilevel analysis. All statistical analyses were performed using SPSS Statistics 26 (IBM, Armonk, NY, USA) with a significance level of < 5% ($p < 0.05$).

Results

We conducted a survey of 888 residents from 37 LTCFs. After the exclusion of 33 individuals who received parenteral nutrition, the data of 855 individuals (191 male and 664 female; mean age, 86.7 ± 7.9 years) were included in the analyses (Fig. 1).

The analyzed participants had a BMI of 20.4 ± 3.6 kg/m^2 and a BI of 30.0 [10.0, 50.0] {median [interquartile range (IQR)]}. CDR values of 0, 0.5, 1, 2, and 3 were observed in 77 (9.0%), 160 (18.7%), 246 (28.8%), and 359 (42.0%) patients, respectively. The median numbers of the remaining and functional teeth were 5.0 [0.0, 15.0] and 26.0 [13.0, 28.0] [median (IQR)]. Overall, 506 (59.2%) individuals received an ND.

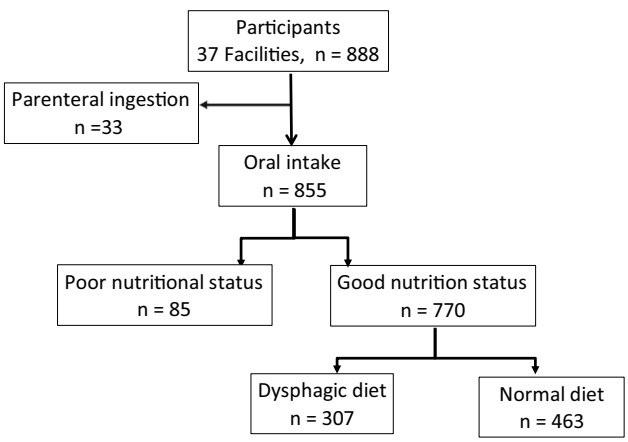

Fig. 1 Flowchart of study participation

The MWST could be assessed in 97.5% of all participants, while the ODK and RSST could only be assessed in 67.0% and 57.8% of the participants, respectively. In comparison, in the brief assessment of the oral cavity, the items could be assessed in 98.6–100% of individuals. The groups with poor and good nutritional intake consisted of 85 (10.0%) and 770 (90.0%) individuals, respectively. A comparison between the two groups showed that the proportions of people consuming an ND in the groups with poor and good nutritional intake status were 50.6% and 60.1% (43 and 463 individuals, respectively). The group with good nutritional intake status had significantly lower age and CDR and included a lower proportion of women than the group with poor nutritional intake status. In addition, BMI, BI, and the number of functional teeth were significantly higher, and the outcome of ODK and MWST was satisfactory in the group with good nutritional intake. Significantly more individuals with masticatory movement, tongue mobility, perioral muscle movement, left–right asymmetric movement of the mouth angle, coughing, changes in voice quality after swallowing, rinsing, and oral residue also had good outcomes (Table 1).

The comparison showed that the group consuming an ND had significantly lower age and CDR values as well as higher BMI and BI values. Therefore, in this group, oral function was more objectively assessed compared to the group consuming a DD. In addition, all brief assessments were associated with a significantly greater percentage of participants with good survey outcomes (Table 2).

Assuming that the participant characteristics differed by site, a multilevel analysis was conducted when the comparison analysis confirmed whether the multilevel analysis was suitable. Therefore, we classified the received food forms into two types (i.e., ND or DD) and performed multilevel analyses with the two food forms as dependent variables. In the objective assessment of oral function, BMI ($p=0.001$), BI ($p<0.001$), CDR score of 3.0 ($p=0.046$), number of remaining teeth ($p=0.011$), number of functional teeth ($p<0.001$), and RSST ($p=0.006$) were significantly associated with discrimination between ND and DD (Table 3).

In addition to BMI and BI, coughing ($p=0.001$) and rinsing ($p=0.029$) were significantly associated with the discrimination between ND and DD (Table 4) in the brief assessment of oral cavity conditions.

Discussion

Key Results

The aim of this study was to discover observational items that would allow recognition of the difficulty in ND intake and indicate the need to consider a transition to a DD. Therefore, we investigated the actual condition of food forms consumed by residents of Japanese LTCFs and examined the factors associated with the discrimination between ND and DD using cross-sectional data. Concerning the items of objective assessments, which were performed by medical professionals, we found that the MWST, number of remaining teeth, and number of functional teeth were significantly related to the received food form. We also investigated whether coughing and rinsing ability, which could be easily observed and evaluated by nursing caregivers, were significantly related to food form. Interestingly, we found that both items could distinguish between individuals consuming an ND or DD.

Simplified assessments were made using items that can be assessed during daily food assistance given by the nursing caregiver close to the older individual requiring long-term care. If changes in these assessments are a sign to consider transitioning from ND to DD, it would be easy to disseminate them to nursing care settings and would be a useful finding to prevent undernutrition, aspiration, and asphyxiation.

Coughing associated with the received food form is a characteristic of the pharyngeal stage of Leopold's five-stage models of ingestion, while rinsing may be related to the preparatory stage [19]. The finding of the significance of rinsing was meaningful, as this ability could be determined by gargling during oral health care. Conversely, most aspects related to the preparatory stage, other than rinsing (i.e., mastication), appear to be related to the received food forms. However, we found no such association in practice. In this regard, the group consuming a DD, which does not require chewing or bolus formation, may not have been accurately assessed because preparatory stage issues often arise in a dietary context.

Consequently, the decision to provide an ND or DD was based on the lower oral and pharyngeal stages, namely swallowing function, in the actual nursing site. In particular, a decrease in the swallowing function suggested the risk of aspiration; thus, it could easily prompt the caregiver to change the food form. Therefore, it should be carefully considered together with the eating function to ensure that the food form is not changed prematurely.

In this study, there was no significant association between the food form and age or CDR. Although it has been reported that having dementia is associated with the presence of swallowing dysfunction [20], the mean age of the participants in this study was approximately 86 years, and the proportion of cognitively impaired individuals with CDR score ≥ 1 was 89.1%, which might have been insignificant. However, the association between rinsing inability and cognitive decline has been reported previously [21]. A previous study also reported an association between cognitive decline and the received food form [5], and the finding of an association

Table 1 Characteristics of study participants, comparison between the poor and good nutrition status groups

Variable	Participants *n* (%)	Overall (*n* = 855)		Poor nutritional status (*n* = 85)		Good nutrition status (*n* = 770)		*p* value
		Mean ± SD *n* (%)	Median [Q1, Q3]	Mean ± SD *n* (%)	Median [Q1, Q3]	Mean ± SD *n* (%)	Median [Q1, Q3]	
Age (years)	851 (99.5)	86.7 ± 7.9	87.0 [82.0, 93.0]	88.5 ± 7.8	89.0 [85.5, 94.0]	86.5 ± 7.9	87.0 [82.0, 92.0]	0.022
Sex (male: female)	855 (100)	664 (77.7)		74:87.1		590:76.6		0.028
Body mass index (kg/m^2)	852 (99.6)	20.4 ± 3.6	20.1 [17.8, 22.7]	18.2 ± 2.9	17.7 [16.2, 20.2]	20.7 ± 3.6	20.5 [18.2, 22.9]	< 0.001
Barthel Index (total points)	855 (100)	32.6 ± 26.0	30.0 [10.0, 50.0]	23.3 ± 24.2	15.0 [0.0, 40.0]	33.6 ± 26.0	30.0 [10.0, 50.0]	< 0.001
Clinical dementia rating (total points)	842 (98.5)							
0, 0.5		77 (9.0)		5 (5.9)		72 (9.3)		< 0.001
1		160 (18.7)		7 (8.2)		153 (19.9)		
2		246 (28.8)		22 (25.9)		224 (29.1)		
3		359 (42.0)		50 (58.8)		309 (40.1)		
Food form (normal diet)	855 (100)	506 (59.2)		43 (50.6)		463 (60.1)		0.089
Objective evaluation of oral function								
Remaining teeth	845 (98.8)	8.38 ± 8.80	5.0 [0.0, 15.0]	7.06 ± 8.00	4.0 [0.0, 13.0]	8.53 ± 9.00	5.00 [0.0, 16.00]	0.203
Functional teeth	845 (98.8)	19.9 ± 10.3	26.0 [13.0, 28.0]	15.6 ± 11.4	15.5 [4.0, 28.0]	20.3 ± 10.1	26.0 [14.0, 28.0]	< 0.001
ODK (/ta/)	573 (67.0)	3.40 ± 1.70	3.6 [2.2, 4.8]	2.98 ± 1.80	2.7 [1.95, 4.25]	3.47 ± 1.70	3.6 [2.4, 4.8]	0.039
RSST	494 (57.8)	2.54 ± 1.50	3.0 [1.0, 4.0]	2.33 ± 1.60	2.0 [1.0, 3.0]	2.56 ± 1.50	3.0 [1.0, 4.0]	0.211
MWST	834 (97.5)	3.11 ± 2.00	4.0 [0.0, 5.0]	2.48 ± 2.20	3.0 [0.0, 4.0]	3.18 ± 2.00	4.0 [0.0, 5.0]	0.004
Simple evaluations (oral conditions)								
Language (possible)	854 (99.9)	570 (66.7)		57 (67.1)		513 (66.7)		0.948
Drooling (none)	852 (99.6)	638 (74.9)		59 (69.4)		579 (75.5)		0.220
Halitosis (none)	855 (100)	558 (65.3)		52 (61.2)		506 (65.7)		0.404
Masticatory movement (move)	855 (100)	730 (85.4)		61 (71.8)		669 (86.9)		0.001
Tongue movement (move)	841 (98.4)	574 (68.3)		46 (55.4)		528 (69.7)		0.008
Perioral muscle (move)	843 (98.6)	671 (79.6)		56 (66.7)		615 (81.0)		0.002
Left–right asymmetric movement of the mouth angle (not)	851 (99.5)	735 (86.4)		66 (77.6)		669 (87.3)		0.014
Swallowing (possible)	854 (99.9)	682 (79.9)		62 (72.9)		620 (80.6)		0.094
Coughing (not)	854 (99.9)	539 (63.1)		41 (48.2)		498 (64.8)		0.003

Table 1 (continued)

Variable	Participants *n* (%)	Overall (*n* = 855)		Poor nutritional status (*n* = 85)		Good nutrition status (*n* = 770)		*p* value
		Mean ± SD *n* (%)	Median [Q1, Q3]	Mean ± SD *n* (%)	Median [Q1, Q3]	Mean ± SD *n* (%)	Median [Q1, Q3]	
Changes in voice quality after swallowing (not)	851 (99.5)	735 (86.4)		65 (76.5)		670 (87.5)		0.005
Respiratory observation after swallowing (no abnormality)	855 (100)	816 (95.4)		79 (92.9)		737 (95.7)		0.267
Rinsing (possible)	855 (100)	491 (57.4)		36 (42.4)		455 (59.1)		0.003
Oral residue (none)	854 (99.9)	401 (47.0)		26 (30.6)		375 (48.8)		0.001

Categorical variables are presented as numbers (percentages) and were analyzed using the chi-square test

Continuous variables (age, body mass index) were analyzed with the *t* test

Continuous variables (Barthel Index, Clinical Dementia Rating, functional teeth, oral diadochokinesis, Modified Water Swallowing Test, Repetitive Saliva Swallow Test) were analyzed with the Mann−Whitney U-test

MWST Modified Water Swallowing Test, *ODK* oral diadochokinesis, *Q1* first quartile, *Q3* third quartile, *RSST* Repetitive Saliva Swallowing Test, *SD* standard deviation

All *p* values < 0.05 were considered statistically significant

between rinsing and food form in this study complements the findings of these previous studies.

ODKs and RSST, which are objective assessments of oral function, were not significantly associated with the received food form. For ODKs and RSST, the participants should understand the content of the test and need to be motivated to perform it more than for the MWST. When water is placed in the mouth, the MWST can assess instinctive swallowing movements, regardless of the participant's comprehension, the test content, or willingness to perform the test. Therefore, the lack of significant differences between the two former tests may have been influenced by the small number of people who could perform and understand the purpose of the tests and were willing to perform them. The MWST was found to be highly sensitive and specific for detecting swallowing dysfunction with small amounts of water [15], as also observed in this study.

Regarding the brief simplified assessment, the researchers used the manual to explain these observations to nurses in advance and evaluated four to five participants along with the nurses to achieve standardization of the criteria. Video endoscopic evaluation of swallowing [22, 23] or video fluoroscopic examination of swallowing [24], the gold standard for eating and swallowing function work-ups, could not be performed in this study. As these tests are difficult to be performed frequently in LTCFs and are performed in non-routine settings, daily eating and swallowing function may not always be assessed. The simplified assessment used in this study was significantly associated with the received food form and could detect inconsistencies between the usual eating and swallowing function and the food form. It seems to be a valid screening assessment that can provide valid outcomes without specific training or other measures and may indicate the need to seek medical attention from specialized medical institutions and experts on dysphagia. It is likely that this easy assessment would be useful and can be disseminated among LTCFs in the future.

Generalizability

The mean age of the analyzed individuals was 86.5 years, the percentage of cognitively compromised individuals with CDR score ≥ 1 was 89.1%, and 39.9% of the individuals consumed a DD. In a survey of nursing home residents (average age 84 years) in the United States, it has been reported that they half-consumed puree-like meals and thickened foods [25]. In the investigation of a special nursing home in Korea, the average age of the residents was 80.7 years, the proportion of patients with mildly to severely reduced cognitive function was 85.8%, and 23.0% of the patients consumed a DD [20]. In a survey focused on Japanese LTCFs, the mean age of residents was 85.2 years, the percentage of cognitively impaired persons with CDR score ≥ 1 was 91.3%, and 52.3% of the patients consumed a DD [26]. The participants

Table 2 Comparison of characteristics of study participants in the Normal and Dysphagia diet groups

Variable	Dysphagia diet ($n=307$)		Normal diet ($n=463$)		p value
	Mean ± SD n (%)	Median [Q1, Q3]	Mean ± SD n (%)	Median [Q1, Q3]	
Age (years)	87.7 ± 7.4	88.0 [83.0, 93.0]	85.6 ± 8.1	86.0 [81.1, 92.5]	< 0.001
Sex (male: female)	240:78.2		350:75.6		0.407
Body mass index (kg/m^2)	19.4 ± 2.9	19.2 [17.3, 21.3]	21.5 ± 3.7	21.5 [19.0, 23.7]	< 0.001
Barthel Index (total points)	17.6 ± 19.1	10.0 [0.0, 30.0]	44.2 ± 24.4	45.0 [25.0, 65.0]	< 0.001
Clinical dementia rating (total points)					
0, 0.5	10 (3.3)		62 (13.4)		< 0.001
1	27 (8.8)		126 (27.2)		
2	69 (22.5)		155 (33.5)		
3	191 (62.2)		118 (25.5)		
Objective evaluation of oral function					
Remaining teeth	6.65 ± 8.0	3.0 [0.0, 11.75]	9.77 ± 9.3	7.0 [0.0, 18.0]	< 0.001
Functional teeth	15.9 ± 11.5	18.0 [3.0, 28.0]	23.3 ± 7.8	28.0 [21.0, 28.0]	< 0.001
ODK (/ta/)	2.75 ± 1.90	3.0 [1.2, 4.15]	3.79 ± 1.53	4.0 [2.8, 5.0]	< 0.001
RSST	2.15 ± 1.43	2.0 [1.0, 3.0]	2.69 ± 1.44	3.0 [2.0, 4.0]	< 0.001
MWST	2.11 ± 2.1	3.0 [0.0, 4.0]	3.9 ± 1.58	4.0 [4.0, 5.0]	< 0.001
Simple evaluations (oral conditions)					
Language (possible)	150 (49.0)		363 (78.4)		< 0.001
Drooling (none)	177 (57.8)		402 (87.2)		< 0.001
Halitosis (none)	182 (59.3)		324 (70.0)		0.002
Masticatory movement (move)	224 (73.0)		445 (96.1)		< 0.001
Tongue movement (move)	147 (48.8)		381 (83.4)		< 0.001
Perioral muscle (move)	201 (66.8)		414 (90.4)		< 0.001
Left–right asymmetric movement of the mouth angle (not)	249 (81.9)		420 (90.9)		< 0.001
Swallowing (possible)	188 (61.4)		432 (93.3)		< 0.001
Coughing (not)	125 (40.8)		373 (80.6)		< 0.001
Changes in voice quality after swallowing (not)	230 (75.4)		440 (95.4)		< 0.001
Respiratory observation after swallowing (no abnormality)	281 (91.5)		456 (98.4)		< 0.001
Rinsing (possible)	100 (32.6)		355 (76.7)		< 0.001
Oral residue (none)	106 (34.5)		269 (58.2)		< 0.001

Categorical variables are presented as numbers (percentages) and were analyzed using the chi-square test

Continuous variables (Age, Body mass index) were analyzed with the *t* test

Continuous variables (Barthel Index, Clinical Dementia Rating, functional teeth, oral diadochokinesis, Modified Water Swallowing Test, Repetitive Saliva Swallow Test) were analyzed with the Mann−Whitney U-test

MWST Modified Water Swallowing Test, *ODK* oral diadochokinesis, *Q1* first quartile, *Q3* third quartile, *RSST* Repetitive Saliva Swallowing Test, *SD* standard deviation

All p values < 0.05 were considered statistically significant

of Japanese studies were older, with a higher proportion of people with cognitive decline. However, older individuals comprise approximately 28.4% of Japan's population, which is the highest worldwide, and the percentage of people with cognitive decline is also high. Consequently, the participants of this study were typical Japanese LTCF residents and likely to be representative of future LTCF residents of the super-aging country. However, those on parenteral nutrition were excluded from the analyses of food form in this study. Therefore, not all residents of Japanese LTCFs were considered in this study.

Validity of the Research Methods

We assumed that when the individuals included in the group with good nutritional intake had a poor nutritional intake despite receiving a food form appropriate for their eating and swallowing function, the food form might not have been

Table 3 Objective evaluation of oral function

	OR crude	95% CI crude	OR adjusted	95% CI adjusted	*p* value
Age	0.999	− 0.001 to 0.006	0.999	− 0.001 to 0.006	0.242
Sex (1: male; 2: female)	0.946	− 0.056 to 0.075	0.939	− 0.063 to 0.068	0.940
Body mass index	0.979	− 0.021 to − 0.006	0.979	− 0.022 to − 0.006	0.001
Barthel Index	0.993	− 0.007 to − 0.004	0.993	− 0.007 to − 0.004	< 0.001
Clinical dementia rating					
0, 0.5	Reference		Reference		
1	0.900	− 0.105 to 0.104	0.904	− 0.101 to 0.109	0.938
2	0.918	− 0.085 to 0.126	0.918	− 0.086 to 0.125	0.719
3	1.024	0.024 to 0.257	1.002	0.002 to 0.236	0.046
Remaining teeth	0.993	− 0.007 to − 0.001	0.993	− 0.007 to − 0.001	0.011
Functional teeth	0.989	− 0.011 to − 0.006	0.989	− 0.011 to − 0.005	< 0.001
ODK (/ta/)	0.967	− 0.033 to 0.008			
RSST	0.961	− 0.040 to 0.007			
MWST	0.960	− 0.041 to − 0.007	0.960	− 0.041 to − 0.007	0.006

CI confidence interval, *MWST* Modified Water Swallowing Test, *ODK* oral diadochokinesis, *OR* odds ratio, *RSST* Repetitive Saliva Swallowing Test

Table 4 Simple evaluations (oral conditions)

	OR crude	95% CI crude	OR adjusted	95% CI adjusted	*p* value
Age	0.999	− 0.001 to 0.006	0.999	− 0.001 to 0.006	0.122
Sex (male: female)	0.946	− 0.056 to 0.075	0.425	− 0.855 to 0.049	0.590
Body mass index	0.979	− 0.021 to − 0.006	0.980	− 0.020 to − 0.004	0.003
Barthel Index	0.993	− 0.007 to − 0.004	0.995	− 0.005 to − 0.001	< 0.001
Clinical dementia rating					
0, 0.5	Reference		Reference		
1	0.900	− 0.105 to 0.104	0.895	− 0.111 to 0.096	0.889
2	0.918	− 0.085 to 0.126	0.913	− 0.091 to 0.119	0.793
3	1.024	0.024 to 0.257	0.963	− 0.038 to 0.197	0.182
Remaining teeth	0.993	− 0.007 to − 0.001	0.994	− 0.006 to 0.000	0.044
Functional teeth	0.989	− 0.011 to − 0.006	0.990	− 0.010 to − 0.004	< 0.001
Language (1: good; 2: bad)	1.013	0.013 to 0.144	0.924	− 0.079 to 0.066	0.865
Drooling (1: no; 2: yes)	1.037	0.037 to 0.177	0.942	− 0.060 to 0.091	0.688
Halitosis (1: no; 2: yes)	0.952	− 0.049 to 0.075			
Masticatory movement (1: good; 2: bad)	1.092	0.088 to 0.260	0.989	− 0.011 to 0.187	0.082
Tongue movement (1: good; 2: bad)	1.095	0.091 to 0.226	0.997	− 0.003 to 0.169	0.058
Perioral muscle (1: good; 2: bad)	1.024	0.024 to 0.179	0.848	− 0.165 to 0.029	0.168
Left−right asymmetric movement of the mouth angle (1: good; 2: bad)	0.935	− 0.067 to 0.095			
Swallowing (1: good; 2: bad)	1.131	0.123 to 0.272	0.995	− 0.005 to 0.174	0.063
Coughing(1: no; 2: yes)	1.124	0.117 to 0.242	1.056	0.054 to 0.198	0.001
Changes in voice quality after swallowing (1: no abnormality; 2: abnormality)	1.069	0.067 to 0.236	0.952	− 0.049 to 0.135	0.364
Respiratory observation after swallowing (1: good; 2: bad)	0.891	− 0.116 to 0.145			
Rinsing (1: possible; 2: impossible)	1.091	0.087 to 0.227	1.010	0.010 to 0.174	0.029
Oral residue (1: no; 2: yes)	1.008	0.008 to 0.136	0.926	− 0.077 to 0.058	0.779

CI confidence interval, *OR* odds ratio

suitable for them. In the comparison between the groups with good and poor nutrition intake, the proportion of the group with a good nutrition intake status consuming an ND was approximately 60.1% ($n=463$) compared to 50.6% ($n=43$) in the group with poor nutrition intake status. In addition, those in the group with good nutritional intake were significantly younger, had a lower CDR, and significantly higher BMI, BI, and number of functional teeth than those in the group with poor nutritional intake. In addition, the results of the performed ODK evaluations and RSST were good, with a significantly higher proportion of people showing good results, even in the short-form assessment of nine out of 15 items. Thus, those with good nutritional status were unlikely to have received a food form that exceeded their functional ability.

In the comparison between the ND and DD groups, there were significant differences in all items, except for sex. These findings also suggested that the food forms suited to the eating and swallowing function of residents were provided.

Significance of the Study

As dementia progresses, appetite decreases, and the amount of received food reduces. It has also been reported that changes in eating behavior because of the progression of dementia are preceded by a decrease in independent eating and swallowing dysfunction [27]. These changes have been reported to reduce food intake and cause undernutrition, dehydration, reduced performance status, and decreased immune and cognitive function, thus, resulting in aspiration pneumonia and increased risk of mortality [27, 28].

For those who need to rely on care for most of their daily life activities, eating is one of the few remaining desires. It has been reported that reduced eating and swallowing function increases the risk of undernutrition and the risk of asphyxia and aspiration, while improving the food form allows the patient to continue eating palatably and safely [29].

The signature that examines the transition from ND to DD revealed by this study may become a valid tool for maintaining dietary safety and appetite in older individuals with a reduced cognitive function requiring nursing care and may inhibit the development of undernutrition, choking, and aspiration in LTCF residents of institutions where experts on dysphagia are not available.

Study Limitations

It should be noted that the facilities surveyed in this study are members of the Society of Geriatrics and Dentistry and that biases in institutional sampling may exist. This study did not perform gold standard tests for assessing eating and swallowing function, such as video fluoroscopy and video endoscopy. However, as objective assessments of the MWST were conducted by dentists specializing in eating and swallowing dysfunction and geriatric dentistry, and an association with the food form was also observed, we believe that the primary endpoint of the food form and its consequences were reasonable. In addition, in this research, we investigated the levels of all examined items in the participants that received the DD, but as the sample size was small, the analysis for all levels did not provide significant results. In addition, as we focused on the distinction between DD and ND, we divided the analysis into those receiving ND and DD. Therefore, we could not analyze each DD separately. Regarding the DD provided in each facility, the viscosity and hardness were not measured. Given that only subjective evaluations were performed according to the IDDSI, it is possible that the standards for thickening were not consistent within and across facilities. We may have had to evaluate factors such as hardness, adhesivity, and cohesivity objectively for the DDs provided by each facility to identify and consider DD biases. Therefore, a study focused on these issues should be conducted in the future. Finally, as the current study was a cross-sectional study, we could not determine the causality between the simplified assessment and the received food form. We plan to follow-up our study's participants and investigate causality.

Conclusion

In conclusion, this study showed that deterioration in the results of a simple assessment such as the ability to cough and rinse that can be implemented on a daily basis by nursing professionals may signal a need to consider changing from ND to DD. It is difficult to perform frequent specialized assessments on eating and swallowing function in nursing care settings. Appropriate switching of food forms may help prevent undernutrition, pneumonitis, asphyxia, and aspiration in older individuals with eating and swallowing dysfunctions. If this simple assessment can be performed periodically by nursing professionals, a mismatch between the received food form and eating and swallowing function can be identified early. The simple evaluation derived in this study should be more widely disseminated.

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Data Availability The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ethico-legal restrictions imposed by the Ethics Committee at the Japanese Society of Gerodontology.

Declarations

Conflict of interest The authors declare no conflict of interest.

Ethical Approval This study was conducted with approval of the Ethics Committee of the Japanese Society of Gerodontology (2018–1) and the Ethics Committee of the Graduate School of Dentistry, Hokkaido University (No. 2020–4).

Informed Consent Written informed consent was obtained from patients and their families.

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Maaya Takeda DDS

Kazutaka Okada DDS, PhD

Miyako Kondo DDS, PhD

Kenshu Taira DDS

Yutaka Watanabe DDS, PhD

Kayoko Ito DDS, PhD

Junko Nakajima DDS, PhD

Yoshie Ozaki DDS, PhD

Rikimaru Sasaki DDS, PhD

Yasuhiro Nishi DDS, PhD

Junichi Furuya DDS, PhD

Kenichi Akino DDS, PhD

Hiromi Ohta DDS

Tomohisa Ohno DDS, PhD

Tsuyoshi Kodama DDS, PhD

Hideo Sakaguchi DDS, PhD

Tetsuo Hanagata DDS, PhD

Yuji Sato DDS, PhD

Mitsuyoshi Yoshida DDS, PhD

Yutaka Yamazaki DDS, PhD

Authors and Affiliations

Maaya Takeda[1] · Kazutaka Okada[1] · Miyako Kondo[1] · Kenshu Taira[1] · Yutaka Watanabe[1] · Kayoko Ito[2] · Junko Nakajima[3] · Yoshie Ozaki[4] · Rikimaru Sasaki[5] · Yasuhiro Nishi[6] · Junichi Furuya[7] · Kenichi Akino[8] · Hiromi Ohta[9] · Tomohisa Ohno[10] · Tsuyoshi Kodama[11] · Hideo Sakaguchi[12] · Tetsuo Hanagata[13] · Yuji Sato[7] · Mitsuyoshi Yoshida[14] · Yutaka Yamazaki[1]

1 Gerodontology, Department of Oral Health Science, Faculty of Dental Medicine, Hokkaido University, Kita 13 Nishi 7, Kita-ku, Sapporo City, Hokkaido 060-8586, Japan

2 Oral Rehabilitation, Niigata University Medical and Dental Hospital, 754 Ichibancho, Asahimachi-dori, Chuo-ku, Niigata City,, Niigata Prefecture 951-8520, Japan

3 Department of Oral Medicine and Hospital Dentistry, Tokyo Dental College, 5-11-13 Sugano, Ichikawa City, Chiba Prefecture 272-8513, Japan

4 Dental Clinic Maruozaki, 15-36, Nishinoguchi-cho, Beppu City, Oita Prefecture 874-0931, Japan

5 Rehabilitation Clinic for Speech and Swallowing Disorders, The Nippon Dental University Hospital, 1-9-20 Fujimi, Chiyoda-ku, Tokyo 102-8158, Japan

6 Department of Oral and Maxillofacial Prosthodontics, Kagoshima University Graduate School of Medical and Dental Sciences, 8-35-1 Sakuragaoka, Kagoshima City, Kagoshima Prefecture 890-8544, Japan

7 Department of Geriatric Dentistry, Showa University School of Dentistry, 2-1-1 Kitasenzoku,, Ohta-ku, Tokyo 145-8515, Japan

8 Public Health Office, Health & Welfare Bureau, Kita 1-jo Nishi 2-chome, Chuo-ku, Sapporo City, Hokkaido 060-0001, Japan

9 Ohta Dental Clinic, 2-24-14 Kamoike, Kagoshima City, Kagoshima Prefecture 890-0063, Japan

10 Hamamatsu City Rehabilitation Hospital, 1-6-1 Wago Kita, Naka-ku, Hamamatsu City, Shizuoka Prefecture 433-8127, Japan

11 Japan Dental Association, 4-1-20, Kudan-kita, Chiyoda-ku, Tokyo 102-0073, Japan

12 Ryouhoku Hospital, 315 Nishi Terakata-cho, Hachioji City, Tokyo 192-0153, Japan

13 Hanagata Dental Clinic, 3-5-22, Tiduka 3-chome, Kofu City, Yamanashi Prefecture 400-0074, Japan

14 Departments of Dentistry and Oral-Maxillofacial Surgery, School of Medicine, Fujita Health University, 1-98, Dengakugakubo, Kutsukake-cho, Toyoake 470-1192, Japan

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Article

Observational Variables for Considering a Switch from a Normal to a Dysphagia Diet among Older Adults Requiring Long-Term Care: A One-Year Multicenter Longitudinal Study

Maaya Takeda [1], Yutaka Watanabe [1,*], Takae Matsushita [1], Kenshu Taira [1], Kazuhito Miura [1], Yuki Ohara [2], Masanori Iwasaki [2], Kayoko Ito [3], Junko Nakajima [4], Yasuyuki Iwasa [5], Masataka Itoda [6], Yasuhiro Nishi [7], Junichi Furuya [8], Yoshihiko Watanabe [9], George Umemoto [10], Masako Kishima [11], Hirohiko Hirano [2], Yuji Sato [8], Mitsuyoshi Yoshida [12] and Yutaka Yamazaki [1]

1 Gerodontology, Department of Oral Health Science, Faculty of Dental Medicine, Hokkaido University, Sapporo 060-8586, Japan; takedamaaya@den.hokudai.ac.jp (M.T.); tkea-224@den.hokudai.ac.jp (T.M.); kenshu.taira@den.hokudai.ac.jp (K.T.); kmiura@den.hokudai.ac.jp (K.M.); yutaka8@den.hokudai.ac.jp (Y.Y.)
2 Tokyo Metropolitan Institute of Gerontology, Tokyo 173-0015, Japan; yohara@tmig.or.jp (Y.O.); iwasaki@tmig.or.jp (M.I.); h-hiro@gd5.so-net.ne.jp (H.H.)
3 Oral Rehabilitation, Niigata University Medical and Dental Hospital, Niigata 951-8520, Japan; k-ito@dent.niigata-u.ac.jp
4 Department of Oral Medicine and Hospital Dentistry, Tokyo Dental College, Tokyo 272-8513, Japan; jun.k.nakajima@gmail.com
5 Department of Dentistry, Haradoi Hospital, Fukuoka 813-8588, Japan; y_iwasa@haradoi-hospital.com
6 Department of Oral Rehabilitation, Osaka Dental University Hospital, Osaka 573-1144, Japan; m.itoda89@gmail.com
7 Department of Oral and Maxillofacial Prosthodontics, Kagoshima University Graduate School of Medical and Dental Sciences, Kagoshima 890-8544, Japan; shar@dent.kagoshima-u.ac.jp
8 Department of Geriatric Dentistry, Showa University School of Dentistry, Tokyo 145-8515, Japan; furuya-j@dent.showa-u.ac.jp (J.F.); sato-@dent.showa-u.ac.jp (Y.S.)
9 Department of Healthcare Management, Tohoku Fukushi University, Sendai 981-8522, Japan; yoshiw@tfu.ac.jp
10 Swallowing Disorders Center, Fukuoka University Hospital, Fukuoka 814-0180, Japan; george@fukuoka-u.ac.jp
11 Wakakusa-Tatsuma Rehabilitation Hospital, Daito 574-0012, Japan; tdbqd500@yahoo.co.jp
12 Department of Dentistry and Oral-Maxillofacial Surgery, School of Medicine, Fujita Health University, Dengakugakubo, 1-98, Kutsukake-cho, Toyoake 470-1192, Japan; mitsuyoshi.yoshida@fujita-hu.ac.jp
* Correspondence: ywata@den.hokudai.ac.jp; Tel.: +81-11-706-4582

Abstract: This one-year multicenter longitudinal study aimed to assess whether older adult residents of long-term care facilities should switch from a normal to a dysphagia diet. Using the results of our previous cross-sectional study as baseline, older adults were subdivided into those who maintained a normal diet and those who switched to a dysphagia diet. The explanatory variables were age, sex, body mass index (BMI), Barthel Index, clinical dementia rating (CDR), and 13 simple and 5 objective oral assessments (remaining teeth, functional teeth, oral diadochokinesis, modified water swallowing test, and repetitive saliva swallowing test), which were used in binomial logistic regression analysis. Between-group comparison showed a significantly different BMI, Barthel Index, and CDR. Significant differences were also observed in simple assessments for language, drooling, tongue movement, perioral muscle function, and rinsing and in objective assessments. In multi-level analysis, switching from a normal to a dysphagia diet was significantly associated with simple assessments of tongue movement, perioral muscle function, and rinsing and with the objective assessment of the number of functional teeth. The results suggest that simple assessments can be performed regularly to screen for early signs of discrepancies between food form and eating/swallowing functions, which could lead to the provision of more appropriate food forms.

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1. Introduction

The prevalence of dysphagia among older adults in Japan is expected to increase, as the country enters a "super-aging" phase [1]. According to a recent Japanese study, the prevalence of dysphagia among healthy older adults living in the community and in nursing homes is 25.1% and 53.8%, respectively [2]. Providing the appropriate food form to patients with dysphagia can help prevent aspiration, asphyxia, and undernutrition as well as maintain quality of life (QOL) [3,4]. However, delayed transition to the appropriate food form due to unnoticed reduced eating/swallowing functions in older adults can increase their risks of preventable complications of dysphagia.

Video fluorography (VF) and video endoscopy (VE) performed by dysphagia specialists are important tools for evaluating the eating/swallowing functions and decide what food form to provide [5,6]. However, these procedures are difficult to perform frequently at home, in certain medical institutions, and in nursing institutions [7].

Caregivers (e.g., nurses, nursing care staff, and family members) may be able to notice a decline in the eating/swallowing functions in older adults who require nursing care for daily activities such as meals, conversations, and oral hygiene. However, if the reduced eating/swallowing functions are mainly due to aging or disuse, the deterioration is often gradual, and the changes are minimal and, thus, can go unnoticed [8].

Promptly detecting discrepancies between eating/swallowing functions and food form through examination at a medical institution specializing in dysphagia and subsequently providing the appropriate food form based on the evaluation is deemed highly important in preventing aspiration, asphyxia, and undernutrition and for maintaining QOL [3].

Previously, we compared older adults requiring nursing care in Japan who were on a normal diet (ND group) with those on a dysphagia diet (DD group) [9]. We conducted a cross-sectional survey based on the hypothesis that non-specialist caregivers could screen food forms through a simple assessment of the eating/swallowing functions that were readily observable, including whether the patient was choking or engaging in rinsing. Therefore, based on the hypothesis that simple assessments could be used to predict switching from a normal to a dysphagia diet, we conducted a one-year prospective multicenter longitudinal study among long-term care facility (LTCF) residents in Japan. We aimed to identify variables that could be used to predict a switch from a normal to a dysphagia diet.

2. Materials and Methods

2.1. Study Design and Participants

This was a one-year prospective multicenter longitudinal study on older adults who were LTCF residents in Japan. We conducted a training session for 30 members of a special committee of the Japanese Society of Gerodontology to explain the study and to standardize the evaluation criteria of the survey. Each member explained the study to the directors and staff of the LTCF they worked with, and eventually 37 LTCF in 17 regions of Japan agreed to participate. The survey was conducted from October 2018 to February 2019. In September 2019, we asked the 37 facilities that had participated in the previous year's study to take part in another survey. Twenty-five facilities agreed, and 431 residents who had completed the previous year's study agreed to participate. The study was approved by the ethics committees of the Japanese Society of Gerodontology (2018-1) and the Hokkaido University Faculty of Dental Medicine (2020 No. 4). Written informed consent was obtained from the 455 residents who had participated in the first year's survey [10]. The survey was conducted in the same manner as the baseline survey (Figure 1).

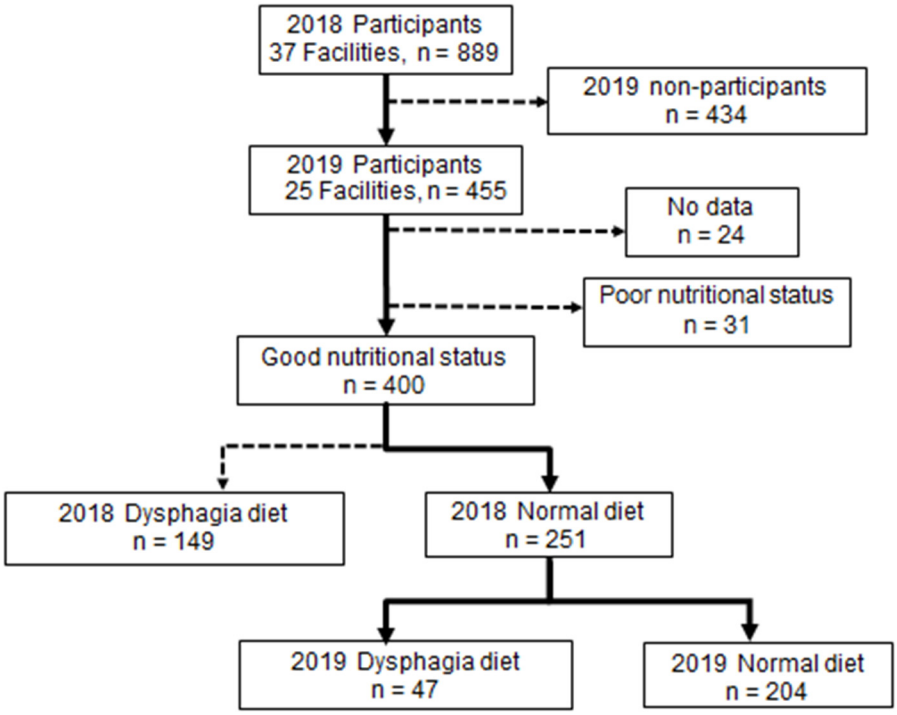

Figure 1. Flow chart of study participation.

2.2. Survey Items

Before the survey, the study members conducted a training session for all the nurses and registered dietitians at their respective facilities on how to evaluate the survey items to standardize the assessment criteria. Thereafter, the survey forms were distributed to the nurses and registered dietitians at each facility to assess the resident participants.

2.2.1. Questionnaire Survey

Basic Information

The registered dietitians obtained the residents' age, sex, and body mass index (BMI) from the nursing care records. The BMI was categorized as follows: 0, $\geq$18.5 kg/m^2; 1, <18.5 kg/m^2 [11].

Life and Cognitive Function Assessment

The nurses conducted a basic assessment of activities of daily living using the Barthel Index (BI) [12]. Cognitive function was evaluated using the Clinical Dementia Rating (CDR) based on the method of Morris et al. [13]. The CDR determines the severity of dementia on a five-point scale as follows: 0, healthy; 0.5, suspected dementia; 1, mild dementia; 2, moderate dementia; 3, severe dementia. One Japanese psychiatrist specializing in dementia and certified as a dementia specialist in Japan checked all assessments and determined the final CDR score.

2.2.2. Oral Status

The nurses assessed the status of the oral cavity based on a food form survey conducted in advance by the LTCF staff, which was collated by the investigators. A manual was used to explain the assessments to the nurses. The nurses were accompanied by an investigator to evaluate 4–5 residents to ensure that the assessment criteria were standardized.

Language was assessed in three grades: 0, able to speak; 1, able to speak but with poor articulation; and 2, unable to speak. An assessment of 0 was classified as "good", while that of 1 or 2 was classified as "poor". Drooling was assessed in three grades: 0, never; 1, sometimes; and 2, always. An assessment of 0 was classified as "good", while that of 1 or 2 was classified as "poor". Halitosis was assessed in three grades: 0, none; 1, slight, and 2,

severe. An assessment of 0 was classified as "good", while that of 1 or 2 was classified as "poor". Tongue movement was assessed in three grades: 0, nearly complete movement; 1, small range of motion; and 2, no movement. An assessment of 0 was classified as "good", while that of 1 or 2 was classified as "poor". Perioral muscle function was assessed in three grades: 0, movement; 1, slight difficulty; and 2, no movement. An assessment of 0 was classified as "good", while that of 1 or 2 was classified as "poor". Left–right asymmetric movement of the mouth angle was assessed in two grades: 0, no; and 1, yes. Rinsing was assessed in three grades: 0, capable; 1, capable but imperfect; and 2, incapable. An assessment of 0 was classified as "good", while that of 1 or 2 was classified as "poor".

Masticatory movement was assessed in three grades: 0, has movement; 1, moves when spoken to; and 2, almost no movement. An assessment of 0 was classified as "good", while that of 1 or 2 was classified as "poor". Swallowing was assessed in two grades: 0, capable, and 1, delayed but capable. Coughing was assessed in two grades: 0, no coughing, and 1, coughing. Changes in voice quality after swallowing was assessed in two grades: 0, no, and 1, yes. Respiratory observation after swallowing was assessed in two grades: 0, no abnormalities, and 1, becomes shallow and fast. Oral residue was assessed in three grades: 0, none; 1, a small amount; and 2, present. An assessment of 0 was classified as "good", while that of 1 or 2 was classified as "poor". The oral condition was assessed by observing it after ordinary meals.

Food form was classified using the Japanese Society of Dysphagia Rehabilitation's 2013 dysphagia diet classification codes [14,15]. The dietitian in charge identified diets classified as dysphagia diets. The nature of the diet and its contents, whether solid or liquid, depended on each subject. This is because the diet being consumed by the residents at the LTCFs was not prepared for the purpose of this study; it was the diet that participants usually ate. Diets containing food cooked or modified to be soft and chewable with weak force and food that did not require special cooking or modification were classified as normal diets.

2.2.3. Measurements

The surveys were conducted by 30 dentists and dental hygienists who were trained in advance and used standardized evaluation criteria.

Oral Status Assessment

The number of functional teeth was the sum of the number of remaining teeth and prosthetic teeth (e.g., implants, pontics, dentures).

Objective Assessment of the Oral Function

1. Oral diadochokinesis (ODK)

This test is a comprehensive measurement of the motor dexterity of the tongue and lips. The residents repeated the sounds /pa//ta//ka/ for 5 s to measure the number of times each syllable was spoken per second using an automatic measuring instrument (Kenkou-kun Handy, Takei Scientific Instruments Co., Niigata, Japan). The cutoff values for /ta/ used in this analysis were 5.2 and 5.4 for men and women, respectively. Therefore, men were assessed as 0: <5.2, 1: ≥5.2, and women as 0: <5.4, 1: ≥5.4 [16].

2. Modified water swallowing test (MWST)

The cervical auscultation method [17] was used with the MWST [18] to evaluate the swallowing function. Following the normal method, 3 mL of cold water was poured into the floor of the oral cavity using a 5 mL syringe, and the resident was instructed to swallow. A stethoscope was then used to evaluate changes in swallowing and respiratory sounds before and after swallowing. An abnormality was considered present (0, abnormal; 1, normal) if there were wet or foamy sounds during pharyngeal swallow or if wheezing or a cough reflex was observed [17].

3. Repetitive saliva swallowing test (RSST)

The RSST [19] was used to evaluate the swallowing function. The investigator instructed the residents to perform as many empty swallows as possible in 30 s in a sitting position. The investigator placed the index and middle fingers on the resident's hyoid bone and laryngeal prominence and counted the number of times the hyoid bone moved above the investigator's fingers during the swallowing reflex. The total number of times was recorded. The results were classified as 0, total <3 and 1, total ≥3.

2.3. Statistical Analysis

The residents were first classified into a group with poor nutritional intake status (<75% of the mean) and a group with good nutritional intake status (≥75% of the mean). The reference values denote that the average daily dietary intake is <75% or ≥75% of the diet provided by a registered dietitian based on a previous study on dysphagia [9]. Residents with poor nutritional status were excluded because they might be provided with food forms that were not suitable for the assessment of eating and swallowing function. The good group was then subdivided into a group that was on a dysphagia diet at baseline (DD group) and a group that was on a normal diet at baseline (ND group). In addition, the ND group was subdivided into a group that was on an ND one year after baseline (ND maintenance group) and a group that was on a DD (DD switched group). The baseline survey items were compared between the two groups. The comparisons between the groups in terms of sex, simple assessments of oral status, and CDR were analyzed using the chi-square test. Continuous variables were tested for normality; subsequently, an unpaired t-test was used for age and BMI, and the Mann–Whitney U test was used for BI, remaining teeth, functional teeth, ODK, MWST, and RSST.

As data from multiple institutions were analyzed, a random effect from the institution was confirmed using multi-level analysis. To examine the factors associated with switching from a normal diet to a dysphagia diet, a multi-level analysis was performed on the 251 residents in the ND group, with staying on an ND one year after baseline or switching to a DD as the dependent variable to calculate the odds ratio (OR) and 95% confidence interval (CI).

The explanatory variables were age and sex, and the covariates were BMI [20], BI [21], and CDR [4], which have been reported to be associated with food form. In addition, remaining teeth, functional teeth, ODK, RSST, and MWST were used as explanatory variables for the objective oral assessments. The explanatory variables of the simple oral assessments included language, drooling, halitosis, masticatory movement, tongue movement, perioral muscle function, left–right asymmetric movement of the mouth angle, swallowing, coughing, changes in voice quality after swallowing, respiratory observation after swallowing, rinsing, and presence of oral residues. All statistical analyses were performed using SPSS Software version 26 (IBM Corp, Armonk, NY, USA), and the significance level was set at 5% ($p < 0.05$).

3. Results

A total of 431 LTCF residents (84 men, 347 women, mean age 87.4 ± 7.9 years) participated in the baseline survey and the survey one year later. Of the 400 residents in the good nutritional intake group, 149 (37.3%) were on a dysphagia diet at baseline in 2018, and 251 (62.7%) were on a normal diet. The ND group had a significantly lower age and CDR, significantly higher BMI and BI, and more functional teeth than the DD group. In addition, this group had significantly higher proportions classified as "good" for all the simple and objective assessment items (Table 1).

Table 1. Comparison of characteristics of the study participants in the 2018 Normal and Dysphagic Diet groups.

Variable	2018 Dysphagia Diet (n = 149)		2018 Normal Diet (n = 251)		Good Nutritional Status (n = 400)		*p*-Value
	Mean ± SD / n (%)	Median, [Q1, Q3]	Mean ± SD / n (%)	Median, [Q1, Q3]	Mean ± SD / n (%)	Median, [Q1, Q3]	
Age	87.5 ± 7.6	89.0 [83.0, 93.0]	85.9 ± 7.8	86.5 [81.0, 92.0]	86.5 ± 7.7	87.0 [82.0, 92.0]	0.042
Sex (female), n (%)	120 (80.5)		201 (80.1)		321 (80.3)		0.912
Body mass index	19.4 ± 2.7	19.4 [17.4, 21.3]	21.9 ± 3.7	21.6 [19.5, 24.1]	21.0 ± 3.6	20.8 [18.5, 22.9]	<0.001
Barthel Index (Total points)	17.7 ± 19.4	10.0 [0.0, 30.0]	44.0 ± 24.8	45.0 [25.0, 60.0]	34.2 ± 26.2	35.0 [10.0, 55.0]	<0.001
Clinical dementia rating (Total points)							
0, 0.5	4 (2.7)		40 (15.9)		44 (11.0)		<0.001
1	14 (9.4)		70 (27.9)		84 (21.0)		
2	36 (24.2)		84 (33.5)		120 (30.0)		
3	90 (60.2)		56 (22.3)		146 (36.5)		
Simple evaluations (Oral conditions)							
Language (possible)	80 (53.7)		203 (80.9)		283 (70.8)		<0.001
Drooling (none)	87 (58.4)		222 (88.4)		309 (77.3)		<0.001
Halitosis (none)	88 (59.1)		178 (70.9)		266 (66.5)		0.015
Masticatory movement (move)	116 (77.9)		241 (96.0)		357 (89.3)		<0.001
Tongue movement (move)	76 (51.0)		207 (82.5)		283 (70.8)		<0.001
Perioral muscle function (move)	102 (68.5)		221 (88.0)		323 (80.8)		<0.001
Left–right asymmetric movement of the mouth angle (not)	116 (77.9)		229 (91.2)		345 (86.3)		<0.001
Swallowing (possible)	91 (61.1)		235 (93.6)		326 (81.5)		<0.001
Coughing (not)	57 (38.3)		201 (80.1)		258 (64.5)		<0.001
Changes in voice quality after swallowing (not)	115 (77.2)		237 (94.4)		352 (88.0)		<0.001
Respiratory observation after swallowing (No abnormality)	140 (94.0)		247 (98.4)		387 (96.8)		0.015
Rinsing (possible)	48 (32.2)		196 (78.1)		244 (61.0)		<0.001
Oral residue (none)	53 (35.6)		137 (54.6)		190 (47.5)		<0.001
Objective evaluation of oral function							
Remaining Teeth	6.0 ± 7.7	3.0 [0.0, 10.8]	10.1 ± 9.5	7.0 [0.0, 19.0]	8.6 ± 9.1	5.0 [0.0, 17.0]	<0.001
Functional teeth	16.4 ± 11.5	21.5 [3.3, 28.0]	23.3 ± 7.5	28.0 [21.0, 28.0]	20.7 ± 9.8	27.0 [15.5, 28.0]	<0.002
ODK (ta)	2.9 ± 2.9	3.0 [0.95, 3.8]	3.9 ± 2.0	4.0 [2.4, 5.0]	3.6 ± 2.3	3.6 [2.2, 5.0]	<0.003
RSST	1.9 ± 1.2	2.0 [1.0, 3.0]	2.7 ± 1.4	3.0 [2.0, 4.0]	2.6 ± 1.4	3.0 [2.0, 3.0]	<0.004
MWST	2.0 ± 2.1	0.0 [0.0, 4.0]	3.8 ± 1.7	4.0 [4.0, 5.0]	3.1 ± 2.1	4.0 [0.0, 5.0]	<0.005

SD = standard deviation, Q = quartile, ODK = oral diadochokinesis, RSST = Repetitive saliva swallowing test, MWST = modified water swallowing test.

Of the 251 residents on a normal diet in 2018, 47 (18.7%) had switched to a dysphagia diet in 2019, and 204 (81.3%) remained on a normal diet. The ND maintenance group had a significantly lower CDR and significantly higher BMI and BI than the DD-switched group. Moreover, the ND maintenance group had significantly higher proportions classified as "good" in the following simple assessments: language, drooling, tongue movement, perioral muscle function, and rinsing. Moreover, the ND maintenance group had significantly higher proportions classified as "good" in the following objective assessments: number of functional teeth, ODK, RSST, and MWST (Table 2).

Table 2. Comparison of characteristics of the study participants in the 2019 Normal and Dysphagic Diet groups.

Variable	2019 Dysphagia Diet (n = 47)		2019 Normal Diet Maintained (n = 204)		*p*-Value
	Mean ± SD / n (%)	Median, [Q1, Q3]	Mean ± SD / n (%)	Median, [Q1, Q3]	
Age	86.3 ± 7.6	86.0 [81.0, 93.0]	85.8 ± 7.8	87.0 [81.0, 92.0]	0.853
Sex (female), n (%)	35 (74.5)		166 (81.4)		0.285
Body mass index	20.8 ± 3.7	20.7 [18.3, 23.0]	22.1 ± 3.6	21.8 [19.7, 24.3]	0.029
Barthel Index (Total points)	35.5 ± 20.0	35.0 [25.0, 50.0]	46.0 ± 25.4	45.0 [25.0, 65.0]	0.009
Clinical Dementia Rating (Total points)					
0, 0.5	1 (2.1)		39 (19.1)		0.036
1	14 (29.8)		56 (27.5)		
2	20 (42.6)		64 (31.4)		
3	11 (23.4)		45 (22.1)		
Simple evaluations (oral conditions)					
Language (possible)	33 (70.2)		170 (83.3)		0.039
Drooling (none)	39 (83.0)		183 (89.7)		0.16
Halitosis (none)	30 (62.8)		148 (72.5)		0.235
Masticatory movement (move)	44 (93.6)		197 (96.6)		0.351
Tongue movement (move)	30 (63.8)		177 (86.8)		<0.001
Perioral muscle function (move)	35 (74.5)		186 (91.2)		0.003
Left–right asymmetric movement of the mouth angle (not)	42 (89.4)		187 (91.7)		0.936
Swallowing (possible)	41 (87.2)		194 (95.1)		0.047
Coughing (not)	34 (72.3)		167 (81.9)		0.141
Changes in voice quality after swallowing (not)	42 (89.4)		195 (95.6)		0.094
Respiratory observation after swallowing (No abnormality)	45 (95.7)		202 (99.0)		0.106
Rinsing (possible)	29 (61.7)		167 (81.9)		0.003
Oral residue (none)	23 (48.9)		114 (55.9)		0.37
Objective evaluation of oral function					
Remaining teeth	9.0 ± 9.2	5.0 [0.0, 18.3]	10.3 ± 9.5	8.0 [0.0, 19.0]	0.475
Functional teeth	20.9 ± 9.5	25.0 [16.3, 28.0]	23.8 ± 6.9	28.0 [22.0, 28.0]	0.08
ODK (ta)	4.4 ± 1.4	4.6 [3.4, 5.4]	3.8 ± 2.1	3.8 [2.4, 5.0]	0.03
RSST	2.0 ± 1.2	2.0 [1.0, 3.0]	3.0 ± 1.4	3.0 [2.0, 4.0]	0.003
MWST	3.3 ± 1.9	4.0 [2.3, 5.0]	4.0 ± 1.6	4.0 [4.0, 5.0]	0.011

SD = standard deviation, Q = quartile, ODK = oral diadochokinesis, RSST = Repetitive saliva swallowing test, MWST = modified water swallowing test.

A multi-level analysis supported the assumption that the characteristics of the participants would differ between institutions. Therefore, the group that was on a normal diet in 2018 was classified into two groups—those who maintained a normal diet (ND maintenance group), and those who switched to a dysphagia diet (DD-switched group) in 2019. These were used as the dependent variables in a multi-level analysis.

First, analysis of each of the simple assessments individually showed that the following were significantly associated with the distinction between a normal and a dysphagia diet: language (OR: 1.02, 95% CI: 0.02–0.25), tongue movement (OR: 1.14, 95% CI: 0.13–0.38), perioral muscle function (OR: 1.13, 95% CI: 0.12–0.42), swallowing (OR: 1.01, 95% CI: 0.01–0.40), coughing (OR: 1.00, 95% CI: 0.00–0.24), and rinsing (OR: 1.11, 95% CI: 0.10–0.32).

In contrast, significant differences were only observed for the objective evaluation of the number of functional teeth (OR: 1.00, 95% CI: 0.00–0.02) (Table 3: Model 1).

Table 3. Results of the multi-level analysis of simple evaluation (oral conditions) and objective evaluation of the oral function.

	Model 1					Model 2					Model 3				
Oral Status	**OR**		**95% CI**			**OR**		**95% CI**			**OR**		**95% CI**		
Language (1: good, 2: bad)	1.02	*	0.02	–	0.25	0.93		−0.08	–	0.17	0.93		−0.07	–	0.17
Drooling (1: no, 2: yes)	0.94		−0.06	–	0.24	0.89		−0.12	–	0.18	0.89		−0.12	–	0.18
Halitosis (1: no, 2: yes)	0.94		−0.06	–	0.15	0.88		−0.13	–	0.08	0.88		−0.13	–	0.08
Masticatory movement (1: good, 2: bad)	0.97		−0.03	–	0.45	0.93		−0.07	–	0.39	0.93		−0.07	–	0.40
Tongue movement (1: good, 2: bad)	1.14	**	0.13	–	0.38	1.06	*	0.06	–	0.31	1.06	*	0.06	–	0.31
Perioral muscle function (1: good, 2: bad)	1.13	**	0.12	–	0.42	1.06	*	0.06	–	0.36	1.05	*	0.05	–	0.36
Left–right asymmetric movement of the mouth angle (1: good, 2: bad)	0.80		−0.22	–	0.11	0.77		−0.26	–	0.05	0.77		−0.26	–	0.05
Swallowing (1: good, 2: bad)	1.01	*	0.01	–	0.40	0.91		−0.09	–	0.29	0.91		−0.09	–	0.29
Coughing (1: no, 2: yes)	1.00	*	0.00	–	0.24	0.94		−0.07	–	0.17	0.94		−0.06	–	0.18
Changes in voice quality after swallowing (1: no abnormality, 2: abnormality)	0.92		−0.08	–	0.33	0.84		−0.17	–	0.23	0.84		−0.17	–	0.24
Respiratory observation after swallowing (1: good, 2: bad)	0.88		−0.13	–	0.60	0.84		−0.17	–	0.52	0.85		−0.16	–	0.54
Rinsing (1: possible, 2: impossible)	1.11	**	0.10	–	0.32	1.01	*	0.01	–	0.25	1.01	*	0.01	–	0.25
Oral residue (1: no, 2: yes)	0.99		−0.01	–	0.19	0.93		−0.08	–	0.13	0.93		−0.07	–	0.14
Objective evaluation of oral function	**OR**		**95% CI**			**OR**		**95% CI**			**OR**		**95% CI**		
Remaining teeth	1.00		0.00	–	0.01	1.00		0.00	–	0.01	1.00		0.00	–	0.01
Functional teeth	1.00	*	0.00	–	0.02	1.00	*	0.00	–	0.01	1.00	*	0.00	–	0.01
ODK (ta) male	0.73		−0.32	–	0.26	0.66		−0.42	–	0.23	0.66		−0.42	–	0.24
ODK (ta) female	0.78		−0.24		0.04	0.78		−0.25		0.04	0.77		−0.26		0.04
RSST	0.70		−0.36	–	0.18	0.84		−0.18	–	0.03	0.93		−0.08	–	0.15
MWST	0.93		−0.07	–	0.22	0.94		−0.06	–	0.16	0.94		−0.06	–	0.16

CI = confidence interval, OR = odds ratio, ODK = oral diadochokinesis, RSST = Repetitive saliva swallowing test, MWST = modified water swallowing test; * $p < 0.05$, ** $p < 0.01$.

Binomial logistic analyses of individual adjustment variables (age, sex, BMI, BI, CDR), with the two categories of maintaining a normal diet and switching to a dysphagia diet as the dependent variable, found significant differences in BMI, BI, and CDR (Table 4).

Table 4. Adjustment variables.

Variable	**OR**		**95% CI**		
Age	1.00		−0.01	–	0.01
Sex (1: male, 2: female)	0.92		−0.08	–	0.15
Body mass index	0.97	*	−0.03	–	0.00
Barthel Index	0.99	**	−0.01	–	0.00
Clinical Dementia Rating					
0, 0.5	Reference				
1	1.09	*	0.08	–	0.36
2	1.16	**	0.15	–	0.43
3	1.14	**	0.13	–	0.45

CI = confidence interval, OR = odds ratio; * $p < 0.05$; ** $p < 0.01$.

Thus, when the BMI, BI, and CDR were used to analyze the simple assessments, significant differences were observed in tongue movement (OR: 1.06, 95% CI: 0.06–0.31), perioral muscle function (OR: 1.06, 95% CI: 0.06–0.36), and rinsing (OR: 1.01, 95% CI: 0.01–0.25). In contrast, significant differences were only observed for the objective evaluation of the number of functional teeth (OR: 1.00, 95% CI: 0.00–0.01) (Table 3: Model 2).

The age, BMI, BI, and CDR were then used as the adjustment variables to analyze each of the simple assessments; significant differences were found in tongue movement (OR: 1.06, 95% CI: 0.06–0.31), perioral muscle function (OR: 1.05, 95% CI: 0.05–0.36), and rinsing (OR: 1.01, 95% CI: 0.01–0.25). Moreover, a significant difference was observed in the objective evaluation of the number of functional teeth (OR: 1.00, 95% CI: 0.00–0.01) (Table 3: Model 3).

Models 1, 2, and 3 showed significant differences for the simple assessments of tongue movement, perioral muscle function, and rinsing, but only for the objective evaluation of the number of functional teeth.

4. Discussion

The objective of this study was to identify observational items that can predict switching from a normal to a dysphagia diet. The results showed that simple assessments that caregivers can observe in daily activities—tongue motions, perioral muscle functions, and rinsing—as well as objective evaluations that can be performed by a dentist or other specialist—number of functional teeth—were associated with switching from a normal to a dysphagia diet. The simple assessments were items that could be observed and evaluated by caregivers who are familiar with older adults requiring nursing care for everyday activities such as dietary assistance and oral care. If changes in these assessments are in fact signs that can predict switching from a normal to a dysphagia diet, this method would be easy to disseminate in nursing care settings and could be used to help decide whether to refer older adults who require nursing care to a medical institution specializing in dysphagia, subsequently preventing undernutrition, aspiration, and asphyxiation.

In our previous cross-sectional study that considered on older adults on a normal and a dysphagia diet as the dependent variable, the simple assessments of coughing and rinsing and the objective evaluations of the number of teeth, number of functional teeth, and RSST were associated with the distinction between a normal and a dysphagia diet. The present study was a longitudinal survey, and we consider the findings beneficial, as the dependent variable was maintaining a normal diet or switching from a normal to a dysphagia diet for each resident.

Coughing, which was associated with food form in the cross-sectional study, is a finding of the pharyngeal stage in the five-phase model of eating and swallowing movements described by Leopold et al., and rinsing is a finding of the preparation stage [22]. Rinsing was significant, possibly because it could be assessed in oral care situations, such as gargling, that are unrelated to food form.

Both tongue movement and perioral muscle function that exhibited significant differences in the present study are preparation stage findings. As these are muscle movements involved in mastication and are related to the food form, the result seems reasonable.

One factor that may have contributed to coughing not showing a significant association in the present longitudinal study is that in the group that switched to a dysphagia diet in 2019, the swallowing function may have declined, and the cough reflex may have been impaired. Therefore, even if the swallowing function declines, if the residents do not cough, it is impossible to make an assessment based on whether the person coughed.

The objective evaluations ODK and RSST, which did not exhibit significant associations in the cross-sectional study, also did not exhibit significant associations in the present longitudinal study. Further, while the MWST exhibited a significant association in the cross-sectional study, it was only significant in Model 1 in the present study. As discussed in the cross-sectional study, for ODK and RSST, the residents should understand and be willing to perform the tests. Comparing the CDR between the residents of the previous

study and those of the present study, we observed that in the previous study, 9.3% of the residents had a CDR of 0 or 0.5, and 19.9% had a CDR of 1, while in the present study, 15.9% had a CDR of 0 or 0.5, and 27.9% had a CDR of 1, indicating that even if the group had a high proportion of participants with relatively good cognitive function, fewer participants were able to perform the test; even among those who could perform the test, only few understood its purpose or had the motivation to perform it. When water is placed in the oral cavity, the MWST can assess instinctive swallowing movements, regardless of the patient's understanding of or willingness to perform the test. While the MWST can reportedly detect dysphagia with high sensitivity and specificity using small amounts of water [18], a significant difference was not observed in the present longitudinal study.

The number of functional teeth was significantly different in both the present longitudinal study and the cross-sectional study, which provides supporting evidence for the previous study. The simple assessments performed in the present study were only explained in advance to the nurses by an investigator using a manual, then the criteria were standardized by performing the evaluations together with an investigator on 4–5 residents; nonetheless, valid results were still obtained. This indicates that a valid result can be obtained without special training, and disseminating this approach is both easy and beneficial.

VE [23,24] and VF [25], the gold standards for conducting a thorough examination of the eating/swallowing functions, could not be performed in the present study [23,24]. However, because these tests are performed in unusual settings, they do not necessarily assess everyday eating/swallowing functions. Further, it is challenging to perform these tests frequently at an LTCF.

Therefore, if a discrepancy between a patient's everyday eating/swallowing functions and food form can be detected by the simple observational items that exhibited significant differences in the present study, this could serve as an effective screening tool for referral to a specialist or specialized medical institution.

We hypothesized that if the nutritional intake status was good, food forms suitable to residents' eating/swallowing functions would be provided. This is because if food forms that go beyond their eating/swallowing functions are provided, the residents are unable to eat them, which would result in the deterioration of their nutritional intake status. In fact, the group with a good nutritional intake status had a significantly higher BMI and more functional teeth than the group with a poor status. Moreover, the good group had significantly higher proportions with good results in several of the simple assessments, including tongue and perioral muscle function. Based on these findings, we believe that residents with a good nutritional intake status are unlikely to be given food forms that go beyond their functional abilities.

When comparing the groups that were on a normal and a dysphagia diet in 2018, significant differences were observed in all items except sex. This result also suggests that food forms suitable to the residents' eating/swallowing functions were being provided.

It is known that when dementia progresses, appetite and food intake decrease. It has also been found that this is preceded by changes in eating behavior due to the progression of dementia, reduced dietary independence, and dysphagia [26]. These changes have been reported to reduce food intake, leading to undernutrition, dehydration, a poorer general condition, and decreased immune and cognitive functions, resulting in an increased risk of aspiration pneumonia and death [26,27]. Another study found that when the eating/swallowing functions decline, in addition to the risk of undernutrition, the risk of suffocation and aspiration also increases [28]. Thus, it is possible to modify the food form so the person can continue eating safely and enjoy meals [29].

The appearance of undernutrition due to decreased eating/swallowing functions in older adults who require nursing care has been reported to substantially affect the severity of their nursing care needs and survival prognosis [30].

In an LTCF, the prevention of incidents such as asphyxiation and aspiration is prioritized over trying to maintain food forms, and many cases of switching to a dysphagia diet

have been reported [10,31]. However, Endo et al. reported that switching from a normal to a dysphagia diet is associated with weight loss in LTCF residents [10], which suggests that the food form should not be changed hastily without any evaluation. The findings that predict switching from a normal to a dysphagia diet as revealed by the present study could be an effective tool to maintain dietary safety and appetite in older adults with cognitive decline who require a high level of nursing care and may help prevent undernutrition, suffocation, aspiration, and other conditions in LTCF that do not have in-house specialists.

This study has some limitations. First, it should be noted that the institutions in this study are affiliated with members of the Japanese Society of Gerodontology, and thus there may be bias in the sampling. Next, the presence/absence and content of dental therapies that could have caused the onset of new diseases, exacerbated comorbidities, or affected oral intake during the study period were not considered. However, as these are highly individualized and infrequent, we believe they had minimal impact on the results. In addition, it should be noted that the results of this study were obtained from people with a good nutritional intake. Lastly, we did not conduct swallowing endoscopy or swallowing angiography, which are the gold standards for assessing the swallowing function. While these examinations are difficult to perform in a multi-center study with many participants, we believe a more detailed study that includes these examinations should be conducted in the future.

5. Conclusions

Our results suggest that items such as tongue movement and perioral muscle function can predict switching from a normal to a dysphagia diet. If these simple assessments could be performed regularly by nursing care workers to screen for early signs of discrepancies between food form and eating/swallowing functions, it could help prevent undernutrition, pneumonia, asphyxia, and aspiration in older adults with dysphagia who require nursing care. Going forward, we intend to take the simple assessments examined in this study to nursing care settings to verify their effects.

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添付した二つの論文（Factors Associated with Food Form in Long-Term Care Insurance Facilities 【 doi: 10.1007/s00455-022-10440-6. 】、 Observational Variables for Considering a Switch from a Normal to a Dysphagia Diet among Older Adults Requiring Long-Term Care: A One-Year Multicenter Longitudinal Study【doi: 10.3390/ijerph19116586.】）を概括して

1 つ目の論文は、日本の介護保険施設の入所者 889 名が摂取している食形態の実態を調査し、ND と DD の判別に関連する因子を横断データを用いて検討した。その結果、医療専門職などが行う客観評価では改訂水飲みテスト（MWST)、現在歯数、機能歯数が有意に食形態と関連していた。そして、介護職等でも観察し評価可能な簡易評価においては、むせとリンシングの可否が有意に食形態と関連していた。簡易評価は、要介護高齢者の身近にいる介護者が毎日の食事介助の場面等で観察し、評価可能な項目である。これら評価の変化が ND から DD への移行を検討するサインであれば介護現場に普及させることは容易であり、低栄養や誤嚥、窒息を防ぐ有益な知見になると思われる。

今回の研究は横断研究であるため、簡易評価と食形態の因果関係を明らかにできていなかった。そこで我々は縦断データにおいても横断データを用いた場合と同様の結果が得られれば、より強い根拠が得られると考え、本研究対象者を追跡調査し、縦断的な関連を検討した。

縦断データを用いた 2 つ目の論文では、介護者等が日常的に観察できる簡易評価においては、舌運動、口腔周囲筋の動きの可否、リンシングが、歯科医師などの専門職が行う客観評価では機能歯数のみが ND から DD への変化に関連していた。

横断および縦断研究ともに、舌運動、口腔周囲筋の動きの可否、リンシングといった項目が、ND から DD への変更を検討ないし予知する所見であることが示唆された。 2 つの研究で同様に関連したこれらの観察項目は、食形態を判定するための観察項目として、信頼性の高い項目であるいえる。

これらの簡易評価を介護職が定期的に行うことで、食形態と摂食嚥下機能の不適合を早期にスクリーニングすることができれば、摂食嚥下障害のある要介護高齢者の低栄養、肺炎、窒息や誤嚥などを予防できると思われる。今後我々は、今回検証した簡易評価を介護現場に普及させ、その効果を検証していくつもりである。