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# Analysis of the Relationship between Eating and Swallowing Function and Lifestyle of the Elderly Living in the Community – A Secondary Publication

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**Abstract:** *Objectives:* The relationship between eating and swallowing function, and lifestyle among community-dwelling elderly people has not been extensively studied. This study aimed to analyze the characteristics of eating and swallowing function and their association with the lifestyle among the elderly. *Methods:* A self-administered questionnaire survey was conducted on 419 elderly people who participated in the oral function improvement project operated by the Community Comprehensive Support Center. A total of 288 valid responses (58 males, 230 females, average age 73.6 years) were analyzed. The survey items included basic demographics, health status, lifestyle, and eating and swallowing functions. The chi-square ($\chi^2$) test was used to compare for a difference in the risk of dysphagia. *Results:* 72 patients (25.0%) were judged to be at risk for dysphagia, and 216 (75.0%) were judged to be not at risk for dysphagia using the revised dysphagia risk assessment scale. The mean score for oral preparatory dysphagia was the highest, while the mean score for pharyngeal dysphagia was the lowest. The group at risk of dysphagia had significant difficulty in chewing and had bad sleep quality as compared to the group that was not at risk. *Conclusion:* Concerning the risk of dysphagia, there is a need to maintain and improve masticatory function. In addition, improving the swallowing function of the elderly may prevent insomnia and improve sleep quality.

**Keywords:** Elderly living in the community; Eating and swallowing function; Lifestyle

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## 1. Introduction

Eating and swallowing sustains life by allowing the passage of food through the oral cavity and into the stomach. As people age, there is a decline in the ability to ingest and swallow due to the aging of the mouth, pharynx, and larynx. This is dangerous for the elderly as it can cause serious diseases such as malnutrition and

aspiration pneumonia, which can adversely affect their quality of life [1,2]. Therefore, it is important to prevent age-related decline in eating and swallowing functions and to prevent aspiration pneumonia among the elderly for them to maintain a healthy life. There have been various reports on the eating and swallowing functions of elderly people living in the community [3–5]. The results of the angiography revealed that approximately 30% of community-dwelling elderly were at risk for dysphagia [3]. It is crucial for elderly people who are at risk for dysphagia to maintain a safe diet. The risk of dysphagia must be detected promptly, and early support for feeding and swallowing problems is necessary to ensure safe eating habits. These measures will ensure a better quality of life for the elderly. In 2006, the Long-Term Care Insurance Law was partially amended, and services for improving oral functions were implemented in the Elderly Health and Welfare Services along with improving motor functions and nutrition intake. This new measure was introduced as a preventive care service. Oral function improvement services consist of providing support for improving eating and swallowing functions, and oral hygiene management. The results of the survey on the implementation of the long-term care prevention project and daily life support showed that 51% of respondents had impaired oral functions [6]. The need for support to prevent the declination of eating and swallowing functions to improve oral functions in the elderly has been increasing. To promote this project, the "Oral Health Care Program" was established to provide a comprehensive oral health care program for the elderly living in the community. Previous studies have shown that the oral functions of the elderly in the community were significantly related to eating and swallowing. In particular, there have been many reports on the association between eating and swallowing functions and diseases [7–9], and studies regarding eating and swallowing functions and oral hygiene in elderly people have been conducted. However, there is still insufficient data [10], and clear support measures to improve the daily lives of the affected elderly have not been strongly established. The purpose of this study was to clarify the relationship between eating and swallowing function and lifestyle among community-dwelling elderly, in the hope of providing possible measures for improvement.

# 2. Methods

## 2.1. Subjects

Elderly people living in City B, Prefecture A, who participated in an oral function improvement project operated by the Regional Comprehensive Support Center were chosen for this study. A total of 419 elderly people were included in this study.

## 2.2. Survey Methodology

### 2.2.1. Research request to the survey facilities

The purpose of this study was explained to the Longevity Care Division of the Welfare Department in City Hall B, Prefecture A, and the Dental Association of City B, and their cooperation in this study was requested. After confirming the department's agreement for cooperation, the 15 community comprehensive support centers in City B were required to explain the purpose and methods of the research.

### 2.2.2. Distribution and collection of questionnaires

After the project was completed, the principal investigator visited each center and explained the purpose of the research to the subjects. A request letter and questionnaire were also distributed to the subjects. Subjects who were willing to consent to the research were asked to respond to the questionnaire. The questionnaires were collected in a closed collection box. In addition, the protection of human rights (the right not to be disadvantaged, the right to self-determination, privacy, anonymity, and personal information) for the subjects

was clearly stated. Subjects that were willing to participate consented out of their own will. The survey period was done from June to December 2013.

## 2.3. Survey Items

### 2.3.1. Basic Attributes

Information regarding the gender, age, and household composition of the subjects was obtained.

### 2.3.2. Health status

Subjects were surveyed for (1) Diseases and medications that affect swallowing, dental and nutritional conditions, and Parkinson's disease; (2) medical history for any diseases caused by abnormalities in the neuromuscular system [8,9]; (3) medications that affect swallowing including antihypertensive medications, tranquilizers, sleeping pills, and diuretics or any drugs that cause dryness of the oral cavity and decreases alertness [8,9]; (4) dental status, mastication status, and oral problems on a 4-point or 5-point scale. The body mass index (BMI) was used as an indicator of nutritional status.

### 2.3.3. Lifestyle habits

Dietary habits, oral hygiene habits, sleeping habits, exercise habits, and social activity habits were surveyed. Eating habits included the number of meals, the time it takes to eat, whether they enjoy eating, and the number of people they eat with. Oral hygiene habits included frequency of tooth brushing, and dental clinic visits whereas sleep habits included nighttime sleep status, and exercise habits included the frequency of exercise and social activities. The survey items of these lifestyle habits were answered by a single-choice response from a 2-point scale or a 5-point scale.

### 2.3.4. Eating and swallowing function

The revised dysphagia risk assessment scale was developed by Fukada et al. [3] as a means of measuring the eating and swallowing function among community-dwelling elderly. The scale consisted of 23 questions and 4 sub-scales: aspiration, pharyngeal dysphagia, and preparatory phase dysphagia. The respondents were asked to indicate the frequency of symptoms that appeared during meals in the past 3 months using a 4-point scale: "Always," "Sometimes," "Rarely," and "Never." The total score was calculated, and a score of 6 or more was considered to be at risk for dysphagia.

## 2.4. Analysis method

Statistical analysis was performed using the IBM SPSS Statistics 19 for Windows and the proportion of patients with and without dysphagia risk were compared using the chi-square ($\chi^2$) test. The results were considered statistically significant at $P < 0.05$ (two-tailed).

## 2.5. Ethical considerations

The study was approved by the Bioethics Committee of Toyohashi University of Creation (Approval No. H2013001, Date of Approval: June 1, 2013). The subjects were informed in writing and orally of the purpose of the research, their freedom to cooperate in the research, and disclosure of the results, and all personal information was protected. This research was conducted with the consent of the subjects.

# 3. Results

The survey was distributed to 419 elderly residents in City B who participated in the oral function improvement project. Of the 346 respondents (82.6% response rate), 288 (83% valid response rate) filled out the questionnaire.

## 3.1. Attributes of the subjects

As shown in **Table 1**, the average age of the subjects was 73.6 ± 6.37 years (mean ± standard deviation), with the majority of subjects aged 65–69 (30.9%). 58 (20.1%) subjects were male, and 230 (79.9%) were female. Households were classified as single-parent households, married-couple households, married-couple households with unmarried children, and single-parent households with unmarried children. Nuclear families accounted for the largest proportion, 148 (51.4%) of the total.

**Table 1.** Attributes of the subjects

| Attributes | Subjects, *n* (%) |
|---|---|
| Age group (years) | |
| 65–69 | 89 (30.9) |
| 70–74 | 83 (28.8) |
| 75–79 | 61 (21.2) |
| > 80 | 55 (19.1) |
| Gender | |
| Male | 58 (20.1) |
| Female | 230 (79.9) |
| Household structure | |
| Single band | 59 (20.5) |
| Nuclear family | 148 (51.4) |
| Third degree | 79 (27.4) |
| No answer | 2 (0.07) |

Notations in the table are given in *n* (%).

## 3.2. Health condition of the subject

As shown in **Table 2**, there were 49 (17.0%) elderly subjects with a history of stroke, Parkinson's disease, etc., and another disease that can cause dysphagia. The number of elderly who were taking medications that affect swallowing, such as diuretics and tranquilizers was 144 (50.2%). The number of the elderly with more than 20 remaining teeth was 132 (45.8%), and 163 (58.0%) could chew normally. The number of elderly who had oral problems, such as dry mouth or unfit dentures was 99 (34.4%). The average BMI was 21.9 ± 4.71 kg/m$^2$, where 21 (7.3%) were underweight, 192 (66.7%) weighed normal, and 48 (16.7%) were obese. The majority of the subjects had normal weights.

**Table 2.** Health status of the subjects

| Health status | Subjects, *n* (%) |
|---|---|
| Diseases affecting swallowing | |
| With previous history | 49 (17.0%) |
| No history | 231 (80.2%) |
| No answer | 8 (2.8%) |
| Drugs that affect swallowing | |
| With oral medication | 144 (50.0%) |
| No oral medication | 141 (49.0%) |
| No answer | 3 (1.0%) |
| Number of remaining teeth | |
| 20 or more | 132 (45.8%) |
| 19 or less | 112 (38.9%) |
| Almost none | 39 (13.5%) |
| No answer | 5 (1.7%) |
| Chewing ability | |
| Can chew most of the time | 282 (97.9%) |
| Cannot chew much | 3 (1.0%) |
| Cannot chew most of the time | 0 (0%) |
| No answer | 3 (1.0%) |
| Oral problems | |
| Yes | 99 (34.4%) |
| No | 179 (62.2%) |
| No answer | 10 (3.5%) |
| BMI* | |
| Underweight | 21 (7.3%) |
| Normal | 192 (66.7%) |
| Obese | 48 (16.7%) |
| No answer | 27 (9.4%) |

The notation in the table is shown in *n* (%). BMI was defined as underweight: less than 18.5 kg/m$^2$; normal: 18.5 or more and less than 25.0 kg/m$^2$; obese: 25.0 kg/m$^2$ or more.

## 3.3. Lifestyle habits of the subjects

As shown in **Table 3**, the number of people eating together was the highest at 156 (54.2%), and the number of times they ate together was the highest at 2. The majority had a meal frequency of 3 meals a day at 281 (97.6%), accounting for more than 90% of the total. More than 90% of the respondents answered that they have a family dentist. In terms of sleeping habits, 226 (78.5%) of the respondents answered that they slept well at night. In terms of exercise and social activity habits, the proportion of respondents who frequently exercised and had regular social activity was higher than those who answered no. The majority of the elderly respondents answered that they exercised, went out, and had social activities daily.

**Table 3.** Lifestyle habits of the subjects

| Lifestyle habits | Subjects, *n* (%) |
|---|---|
| Number of people eating together | |
| 1 | 56 (19.4%) |
| 2 | 156 (54.2%) |
| More than 3 | 72 (25.0%) |
| Number of meals | |
| 3 meals a day | 281 (97.6%) |
| Other than 3 meals a day | 3 (1.0%) |
| No response | 4 (1.4%) |
| Duration of meal | |
| Up to 5 points | 17 (5.9%) |
| 15 points | 160 (55.6%) |
| 30-point scale | 109 (37.8%) |
| No response | 2 (0.7%) |
| Enjoyment during eating | |
| Always | 163 (56.6%) |
| Sometimes | 104 (36.1%) |
| Rarely | 9 (3.1%) |
| No answer | 12 (4.2%) |
| Oral hygiene | |
| Daily | 275 (95.5%) |
| Several times a week | 10 (3.5%) |
| Rarely | 1 (0.3%) |
| No answer | 2 (0.7%) |
| Family dentist | |
| Yes | 259 (89.9%) |
| No | 25 (8.7%) |
| No answer | 4 (1.4%) |
| Nighttime sleep status | |
| Sleeping well | 226 (78.5%) |
| Not sleeping | 50 (17.4%) |
| No answer | 12 (4.2%) |
| Exercise | |
| Daily | 143 (49.7%) |
| Several times a week | 103 (35.8%) |
| Rarely | 37 (12.8%) |
| No answer | 5 (1.7%) |

**Table 3** (Continue)

| Lifestyle habits | Subjects, *n* (%) |
|---|---|
| Opportunity to go out | |
| Daily | 159 (55.2%) |
| Several times a week | 112 (38.9%) |
| Rarely | 9 (3.1%) |
| No answer | 8 (2.8%) |
| Social activity | |
| Daily | 211 (73.3%) |
| Several times a week | 70 (24.3%) |
| Rarely | 4 (1.4%) |
| No answer | 3 (1.0%) |

Notations in the table are given in *n* (%).

## 3.4. Evaluation of the subject's risk of dysphagia

The mean (standard deviation) of all items of the revised dysphagia risk scale was 3.97 (4.84), and 216 (75.0%) elderly subjects were determined to have no dysphagia risk. The total score was 6 or more points, indicating that there was a risk of dysphagia. The mean (standard deviation) of each of the four subscale scores was 0.05 for pharyngeal dysphagia. The mean (standard deviation) of each of the four subscales was 0.59 (1.26) for pharyngeal dysphagia, 1.07 (1.66) for aspiration, 1.07 (1.66) for preparatory, 1.50 (2.28) for dysphagia in the preparatory and oral phases, 0.81 (1.81) for dysphagia in the esophageal phase, and 1.07 (1.66) for aspiration. The mean score of dysphagia in the preparatory and oral stages was the highest, and that of dysphagia in the pharyngeal stage was 0.81 (1.29).

Next, for each question item, the answers for "always", "sometimes," and "rarely" were subjective symptoms (1-3 points). The percentage of respondents who answered "rarely" was categorized as having no subjective symptoms (0 points). As shown in **Table 4**, The highest percentage of respondents experienced subjective symptoms of heartburn when swallowing water or food (30.9%). On the other hand, the subjective symptom that received the lowest response was food remaining on the tongue after swallowing (3.1%).

**Table 4.** Presence of subjective symptoms on the dysphagia risk assessment scale

| Subjective symptoms | Yes, *n* (%) | No, *n* (%) |
|---|---|---|
| Pharyngeal dysphagia | | |
| 1. Moisture or food rises to the nose | 23 (8.0) | 265 (92.0) |
| 2. Does not swallow food, continuous chewing | 17 (5.9) | 271 (94.1) |
| 3. Difficulty swallowing water | 18 (6.2) | 270 (93.8) |
| 4. Difficulty swallowing food | 11 (3.8) | 277 (96.2) |
| 5. Food feels stuck in the throat | 35 (12.2) | 253 (87.8) |
| 6. Food feels like it stays in the throat | 16 (5.6) | 272 (94.4) |
| 7. Voice turns muddy during or after eating | 14 (4.9) | 274 (95.1) |
| Pulmonary aspiration | | |
| 8. Swallowing or coughing as soon as water or food enters the mouth | 66 (22.9) | 222 (77.1) |

**Table 4** (Continue)

| Subjective symptoms | Yes, *n* (%) | No, *n* (%) |
|---|---|---|
| 9. Choking when swallowing water or food | 83 (28.8) | 205 (71.2) |
| 10. Choking after swallowing water or food | 51 (17.7) | 237 (82.3) |
| 11. Choking when swallowing water | 49 (17.0) | 239 (83.0) |
| 12. Choking when swallowing food | 21 (7.3) | 267 (92.7) |
| Dysphagia during the preparatory and oral phases | | |
| 13. Difficulty chewing | 34 (11.8) | 254 (88.2) |
| 14. Eats only soft foods | 54 (18.7) | 234 (81.3) |
| 15. Dry mouth | 60 (20.8) | 228 (79.2) |
| 16. Dry and mushy food is difficult to swallow | 66 (22.9) | 222 (77.1) |
| 17. Food spills from the mouth | 28 (9.7) | 260 (90.3) |
| 18. Slurred speech | 37 (12.8) | 251 (87.2) |
| 19. Food remains on the tongue after swallowing | 9 (3.1) | 279 (96.9) |
| 20. Slow eater | 48 (16.7) | 240 (83.3) |
| Esophageal dysphagia | | |
| 21. Reflux of food and acidic liquids | 60 (20.8) | 228 (79.2) |
| 22. Feeling that food is stuck in the chest | 48 (16.7) | 240 (83.3) |
| 23. Heartburn | 89 (30.9) | 199 (69.1) |

Notations in the table are given in *n* (%).

## 5. Comparison of dysphagia risk with demographics, health status, and lifestyle

In the revised dysphagia risk scale, more than 2 items were classified as "always" and more than 6 items were classified as "rarely" or "always." If there were more than 2 items under "always" or more than 6 items under "rarely," the total score was determined to be 6 points or more. Subjects who scored 6 or more points were considered to be at risk for dysphagia. The subjects were divided into two groups: 72 were at risk of dysphagia and 216 were not at risk of dysphagia. The relationship between the attributes, health status, and lifestyle was compared. As shown in **Table 5**, there were significant differences in the category of age, sex, and household composition when compared between the two groups.

As shown in **Table 6**, the percentage of those with dysphagia risk was higher than that of those with diseases affecting swallowing function. The proportion of those with a history of diseases affecting swallowing was 42.9%, almost twice as high as that of those without such a history (21.2%). Similarly, 32.6% of respondents at risk for dysphagia were taking medications that affected swallowing functions while 17.7% of respondents were not taking such medications. The number of respondents with dysphagia risk was about twice as high as those without dysphagia risk. In terms of mastication ability, those who did not experience difficulty in chewing were significantly less likely to be at risk of dysphagia. There was a significantly lower percentage of those at risk for dysphagia among those who did not have difficulty chewing as compared to those who did ($P = 0.032$). In addition, respondents who experienced oral problems were more likely to have swallowing problems and had a higher risk of dysphagia ($P < 0.001$).

**Table 5.** Comparison of risk of dysphagia with attributes

| Attributes | At risk of dysphagia, *n* (%) | No risk of dysphagia, *n* (%) | *P* |
|---|---|---|---|
| Age group (years) | | | |
| 65–69 | 18 (20.2) | 71 (79.8) | |
| 70–74 | 23 (27.7) | 60 (72.3) | |
| 75–79 | 16 (26.2) | 45 (73.8) | 0.657 |
| > 80 | 15 (27.3) | 40 (72.7) | |
| Gender | | | |
| Male | 18 (31.0) | 40 (69.0) | 0.235 |
| Female | 54 (23.5) | 176 (76.5) | |
| Household structure | | | |
| Single-parent | 14 (23.7) | 45 (76.3) | |
| Nuclear family | 36 (24.3) | 112 (75.7) | 0.778 |
| Three households | 22 (27.8) | 57 (72.2) | |

Notations in the table are given in *n* (%).

**Table 6.** Risk of dysphagia vs. health status

| Attributes | At risk of dysphagia, *n* (%) | No risk of dysphagia, *n* (%) | *P* |
|---|---|---|---|
| Diseases affecting swallowing | | | |
| With previous history | 21 (42.9) | 28 (57.1) | 0.001 |
| No history | 49 (21.2) | 182 (78.8) | |
| Drugs that affect swallowing | | | |
| With oral | 47 (32.6) | 97 (67.4) | 0.004 |
| No oral | 25 (17.7) | 116 (82.3) | |
| Number of remaining teeth | | | |
| 20 or more | 33 (25.0) | 99 (75.0) | |
| Less than 19 | 24 (21.4) | 88 (78.6) | 0.492 |
| Almost none | 12 (30.8) | 27 (69.2) | |
| Mastication ability | | | |
| Can chew anything | 34 (20.9) | 129 (79.1) | 0.032 |
| Cannot chew some things | 38 (32.2) | 80 (67.8) | |
| Oral problems | | | |
| Yes | 47 (47.5) | 52 (52.5) | < 0.001 |
| No | 22 (12.3) | 157 (87.7) | |
| BMI* | | | |
| Underweight | 6 (28.6) | 15 (71.4) | |
| Normal | 51 (26.6) | 141 (73.4) | 0.683 |
| Obese | 10 (20.8) | 38 (79.2) | |

The notation in the table is shown in *n* (%).

*BMI was defined as underweight: less than 18.5 kg/m$^2$; normal: 18.5 to 25.0 kg/m$^2$; obese: 25.0 kg/m$^2$ and over 25.0 kg/m$^2$.

As shown in **Table 7**, when comparing dysphagia risk and lifestyle, the proportion of those who had not slept well was 40.0%, almost twice as high as that of those who had slept well (20.8%). The proportion of respondents who enjoyed eating had a lower risk of dysphagia as compared to those who did not enjoy eating. A significant difference was found when comparing respondents who enjoyed eating as compared to those who did not ($P$ = 0.004). There was also a significant difference between respondents who liked going outside as compared to those who did not (P = 0.011).

**Table 7.** Risk of dysphagia vs. health status

| Attributes | At risk of dysphagia, *n* (%) | No risk of dysphagia, *n* (%) | *P* |
|---|---|---|---|
| Number of people eating together | | | |
| 1 person | 14 (25.0) | 42 (75.0) | |
| 2 persons | 36 (23.1) | 120 (76.9) | 0.586 |
| More than 3 persons | 20 (27.8) | 52 (72.2) | |
| Number of meals | | | |
| 3 meals a day | 68 (24.2) | 213 (75.8) | 0.714 |
| Other than 3 meals a day | 1 (33.3) | 2 (66.7) | |
| Duration of meal | | | |
| Within 5 points | 5 (29.4) | 12 (70.6) | |
| 15-point scale | 41 (25.6) | 119 (74.4) | 0.797 |
| 30-point scale | 25 (22.9) | 84 (77.1) | |
| Enjoyment during eating | | | |
| Always | 29 (17.8) | 134 (82.2) | |
| Sometimes | 37 (35.6) | 67 (64.4) | 0.004 |
| Rarely | 3 (33.3) | 6 (66.7) | |
| Oral hygiene | | | |
| Daily | 66 (24.0) | 209 (76.0) | |
| Several times a week | 5 (50.0) | 5 (50.0) | 0.148 |
| Rarely | 0 (0.0) | 1 (100.0) | |
| Family dentist | | | |
| Yes | 66 (25.5) | 193 (74.5) | 0.871 |
| None | 6 (24.0) | 19 (76.0) | |
| Nighttime sleep status | | | |
| Sleeping | 47 (20.8) | 179 (79.2) | 0.004 |
| Not sleeping | 20 (40.0) | 30 (60.0) | |
| Exercise | | | |
| Daily | 31 (21.7) | 112 (78.3) | |
| Several times a week | 32 (31.1) | 71 (68.9) | 0.214 |
| Rarely | 8 (21.6) | 29 (78.4) | |

**Table 7** (Continue)

| Attributes | At risk of dysphagia, *n* (%) | No risk of dysphagia, *n* (%) | *P* |
|---|---|---|---|
| Opportunity to go out | | | |
| Daily | 38 (23.9) | 121 (76.1) | |
| Several times a week | 25 (22.3) | 87 (77.7) | 0.011 |
| Rarely | 6 (66.7) | 3 (33.3) | |
| Social activity | | | |
| Daily | 52 (24.6) | 159 (75.4) | |
| Several times a week | 17 (24.3) | 53 (75.7) | 0.504 |
| Rarely | 2 (50.0) | 2 (50.0) | |

Notations in the table are given in *n* (%).

## 6. Considerations

In this study, we conducted a study of the oral function improvement project operated by the Community Comprehensive Support Center for community-dwelling elderly. 72 (25.0%) of the elderly residents who participated were determined to be at risk for dysphagia. This indicated that about one out of every four people is at risk for dysphagia. The risk of aspiration in this study was higher than that reported by Kamakura et al. [10], who reported that 12.7% of homebound elderly aged 65 years and older were at risk of aspiration. However, the results of the survey may be influenced by regional characteristics and the demographics of the target population. Nonetheless, the results still prove that early support and interventions are necessary to ensure that elderly people living with dysphagia can maintain a normal and healthy lifestyle.

The dysphagia risk scale used in this study showed that the mean score under the preparation and oral phase was the highest, and the mean score for pharyngeal dysphagia was the lowest. In other words, there was a greater awareness of symptoms related to the preparatory and oral phases among the elderly. The results of a study on community-dwelling elderly patients with dysphagia showed that 63% had abnormalities in the oral cavity [11] following angiography. The proportion of elderly patients with oral disorders was high and was mainly affected in the pharyngeal region. The preparatory and oral phases are when food is taken into the mouth, chewed, and swallowed. Many patients responded with having experienced dry mouth and difficulty in swallowing dry and mushy food. This indicated that oral dryness was a common symptom. The main cause of oral dryness is thought to be a decrease in saliva secretion due to aging, disease, or side effects of oral medications. Ibayashi et al. [12] found that oral cleaning and exercises increased salivary flow and improved swallowing functions. Therefore, the amount of saliva secretion in elderly people living in the community should be measured, and guidance on oral cleaning and oral exercises should be provided to increase saliva production in light of the oral function improvement project.

On the other hand, there was less awareness of symptoms related to the pharyngeal stage of dysphagia. The pharyngeal phase is the process of transporting the food mass from the pharynx into the esophagus and is closely associated with aspiration. However, the low percentage of responses to the subjective symptoms of difficulty swallowing rice or water indicated that difficulty swallowing could not be easily perceived. The results indicated that older adults living in the community had fewer subjective symptoms that directly cause difficulty in eating and swallowing. The lack of subjective symptoms is one of the reasons why the oral health improvement program was not widely implemented, and the fact that the elderly themselves are not aware of

the importance of oral health care. Therefore, it is likely that swallowing and coughing are caused not only by aging but also by a decline in eating and swallowing function and aspiration pneumonia. Hence, the oral health improvement program needs to be established and strongly promoted to raise awareness among the elderly regarding the importance of oral health.

There is an association between the risk of dysphagia and the attributes, health status, lifestyle habits, and masticatory function of the elderly. The presence of a history of disease affecting swallowing was also strongly associated with dysphagia, similar to the results of other reports [9,10–14]. Elderly who had no difficulty in chewing had lower risks of dysphagia as compared to those who did. On the other hand, there was no association between the risk of dysphagia and the number of remaining teeth. The results suggested that it was crucial to maintain the ability to chew food while using dentures. Chewing is the process of forming a food mass that is easy to swallow. Therefore, it is necessary to maintain and improve the masticatory function of the elderly to prevent dysphagia.

Lifestyle factors such as enjoyment of food, frequency of going out, and sleep status were associated with the risk of dysphagia. The risk of dysphagia was lower among the elderly who enjoyed eating as compared to those who did not enjoy eating. Results showed that dysphagia could lead to swallowing and coughing, making eating less enjoyable. This was considered to be a possible cause of eating difficulties. The elderly who rarely went outside were significantly more at risk for dysphagia than those who went out more frequently, although the number of subjects that went out was insignificant. The results of the present study were consistent with Kamakura et al. [10], who found that the elderly who spent most of their time at home were significantly more likely to have swallowing problems. Staying at home for long periods can accelerate the weakening of muscle tissue and ligament laxity that comes with aging [16].

Elderly with unhealthy sleep habits were at higher risk for dysphagia. In this study, the survey showed that 50 respondents were not able to sleep at night, and a high percentage (40%) of them were at risk for dysphagia. Okuno et al. [17] found that coughing after swallowing and repeated swallowing were more common during sleep in normal subjects. This may lead to arousal, making it difficult to reach resting eye movement (REM) sleep. In addition, the coordination between inhalation and swallowing as a defense mechanism is greatly diminished during sleep [18]. Decreased swallowing function may affect nighttime sleep. However, this study did not reveal a causal relationship between poor sleep habits and the risk of dysphagia. Nonetheless, the results suggested that improving the swallowing function of the elderly may help improve the quality of their sleep.

This study has several limitations. Firstly, it is a cross-sectional study. The risk of dysphagia might not be accurately determined by a self-administered questionnaire. In the present analysis, there may be confounding factors that affect the risk of dysphagia. The survey was also only limited to the elderly who participated and cooperated in the oral health improvement project, and we have not been able to differentiate between those who cooperated in the survey and those who did not. Furthermore, eight years have passed since the survey was conducted. However, there have been few papers focusing on the relationship between eating and swallowing functions and lifestyle habits during then and the results of this study are yet to be published. Nonetheless, this study is expected to improve the deliverance and quality of support for elderly with eating and swallowing disorders by clarifying their characteristics and issues to improve their quality of life.

## 7. Conclusion

Out of the 288 elderly residents in the community who participated in the oral function improvement project, 72 (25.0%) subjects were at risk of dysphagia, and approximately 4.5% had swallowing problems. This indicated

that about one in four elderly people in the community is at risk of dysphagia. The elderly were also more aware of symptoms related to the preparatory and oral phases but were less aware of symptoms related to the pharyngeal phase.

Concerning the risk of dysphagia, there is a need to maintain and improve masticatory function and opportunities for social activities. The results suggested that support for improving mastication and increased opportunities for the elderly to go out could prevent dysphagia. In addition, dysphagia may adversely affect nighttime sleep. Results suggested that improving swallowing functions in the elderly may assist in improving sleep quality.

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## Disclosure statement

The authors declare no conflict of interest.

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