

Singing Habit Potentially Prevents the Oral Frailty of Japanese Healthy Middle-Aged and Elderly Individuals

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Abstract

Background: Focus has recently been placed on the importance of taking measures against the oral frailty of healthy elderly individuals.

Objective: To exploratorily examine the association of singing habit with the oral frailty of Japanese healthy middle-aged and elderly subjects.

Methods: Self-reported questionnaire surveys on singing habit, oral frailty, social isolation, and depressive tendency were conducted. Pearson's correlation coefficients were calculated, and simple linear regression analysis assessed the association of an independent variable (singing habit scores) with a dependent variable [oral frailty index (OFI)-8 scores], while multiple linear regression analysis assessed the associations of independent variables (age, gender, as well as the presence or absence of singing habit, social isolation, and depressive tendency) with the OFI-8 scores.

Results: 32 subjects (6 males and 26 females; mean age, 69.0±5.6 years) participated in the surveys. The OFI-8 scores ranged from 0 to 11 points (mean score: 3.3±2.3 points), with the most predominant score of 4 points (8/32, 25.0%). Simple linear regression analysis (n=32) revealed that singing habit significantly lowered the OFI-8 scores (p=0.045), although no correlation was detected (R²=0.1269). Multiple linear regression analysis (n=31) revealed that singing habit showed a moderate inverse correlation (β , -1.73; r=-0.44) with and significantly lowered the OFI-8 scores (p=0.03), suggesting its potential of reducing the risk of oral frailty. Age, social isolation, and depressive tendency had no significant association with the OFI-8 scores.

Conclusion: The present exploratory study does not provide conclusive evidence about oral frailty prevention by singing habit but affords underpinnings for further research.

Keywords: Singing Habit, Oral Frailty, Depression, Social Isolation, Healthy Middle-Aged and Elderly Individuals, Self-reported Questionnaire Surveys

1. Introduction

The total population of Japan in 2016 was 126.93 million according to the 2017 Statistical Handbook of Japan published by the Ministry of Internal Affairs and Communications (Chino, 2017), 27.3% of which were accounted for by the elderly aged 65 years or older—the highest aging rate in the world. The elderly population in Japan has gradually increased, while its total population has been declining and its average lifespan is increasing. Hence, a social challenge has emerged that intends to extend the life free of daily life restrictions (i.e., healthy life expectancy) to reduce healthcare costs. In 2019, the Ministry of Health, Labour and Welfare of Japan established the Healthy Life Expectancy Extension Plan, the goals of which are to extend the expectancy by more than 3 years for both men and women not later than 2040 compared with the 2016 expectancy and to achieve a healthy life expectancy of over 75 years.

The concept of frailty proposed by Buchner and Wagner (Buchner & Wagner, 1992) is understood as a state that is prone to present aging-associated health problems due to various functional changes and to a decrease in reserve capacity. To date, different scales have been designed to measure frailty [e.g., the Canadian Study of Health and Aging Clinical Frailty Scale (Rockwood et al., 2005), the Edmonton Frail Scale (Petty et al., 2006), and the Tilburg Frailty Indicator (Gobbens et al., 2010)], as with the screening tools for oral frailty [e.g., the D-E-N-T-A-L

Questionnaire (Bush, Horenkamp, Morley & Spiro, 1996) and the Eating Assessment Tool-10 Questionnaire (Belafsky et al., 2008)]. The prevention of frailty by adopting healthy lifestyles [e.g., adequate nutrition (GBD 2017 Diet Collaborators, 2019) and moderate exercise (Reiner, Niermann, Jekauc & Woll, 2013) in conjunction with the prevention and early detection of disease] is a cornerstone for the extension of healthy life expectancy (Kojima, Satake, Osawa & Arai, 2021).

The effective management of oral frailty can prevent or ameliorate physical frailty and the need for nursing care (Shirobe et al., 2022) in older adults who commonly present with poor oral health that may impair essential activities of daily living and contribute to frailty (Dibello et al., 2021). In a 4-year longitudinal study in Japanese elderly individuals that examined 6 oral frailty components (dental status [e.g., number of remaining teeth], oral function [e.g., maximal oral pressure], articulatory oral motor skill [i.e., vocalization of “pa,” “ta,” and “ka”], tongue pressure, oral wettability, and subjective measures [e.g., difficulty eating tough foods]), oral frailty—conceptualized as accumulated poor oral status—significantly predicted susceptibility to physical frailty, sarcopenia, the subsequent need for long-term nursing care, and mortality (Tanaka et al., 2018).

Oral exercises for improving oral functions—occlusal force, tongue pressure, tongue-motor function, and masticatory function (e.g., tongue muscle strengthening training and tongue rotation/swallowing exercises) have been advocated to prevent oral frailty (Kito et al., 2019), among which singing can be effective in improving the mental health and oral condition of the elderly (Sakano et al., 2014). Furthermore, psychological benefits of solo or group singing were suggested in some people suffering from respiratory illness (Gick & Nicol, 2016), social benefits of choral singing in individuals from small and large community choirs (Weinstein et al., 2016), and cognitive benefits of musical therapy intervention in patients with Alzheimer’s disease (Satoh et al., 2015). Based on such a multifaceted research context, we aimed to exploratorily examine the associations of age, singing habit, social isolation, and depressive tendency with the oral frailty of Japanese healthy middle-aged and elderly individuals.

2. Subjects and Methods

2.1 Procedure and Subject Participation

This open-label study on singing habit was conducted in July to August, 2020. Thirty-two Japanese healthy middle-aged and elderly subjects (6 men and 26 women; mean ages for all subjects, males, and females: 69.0 ± 5.6 , 65.2 ± 4.4 , and 69.8 ± 5.6 years, respectively) aged 60 years or older participated in various self-reported questionnaire surveys. The ethics committee of Wayo Women’s University approved the study protocol (No. 2003). Each subject received written and verbal information about the study protocol before providing written informed consent.

2.2 Risk Assessment of Oral Frailty

We used an oral frailty index (OFI)-8 screening questionnaire (Tanaka et al., 2021). The questionnaire posed 8 questions. Subjects responded to each question by selecting either of response choices—“Yes” or “No”; an OFI-8 score of 1 or 2 points was allocated to each choice (Table 1). We calculated the total OFI-8 score for 8 questions and categorized the risk of oral frailty to the following groups: the low-risk group: 0-2 points; the intermediate-risk group: 3 points; and the high-risk group: ≥ 4 points.

Table 1. OFI-8 screening questionnaire

Questions	Response choices, points	
	Yes	No
Difficulty eating tough foods compared with half a year ago	2	
Occasional choking with tea and/or soup	2	
Use of dentures	2	
Concern about oral dryness	1	
Less frequency of going outside compared with half a year ago	1	
Ability of biting foods as tough as pickled radish		1
Brushing of teeth twice or more a day		1
Visit a dentist once or more a year		1

Note. OFI, oral frailty index.

2.3 Survey on Singing Habit

We used a signing habit questionnaire to investigate subjects' singing frequency, with the score range of 1 point (no signing habit) to 7 points (singing twice or more almost every day) (Table 2).

Table 2. Singing habit scores

Score, points	Singing frequency
1	No singing habit
2	Singing approximately once or twice a month
3	Singing approximately once or twice a week
4	Singing approximately twice or 3 times a week
5	Singing approximately 4-5 times a week
6	Singing almost every day
7	Singing twice or more almost every day

2.4 Screening for the Social Isolation of Middle-Aged and Elderly Individuals

We used the Japanese version of the abbreviated Lubben social network scale-6 (LSNS-6) questionnaire (Lubben et al., 2006) (Table 3) to assess the social isolation of healthy elderly individuals. Questions 1 to 3 queried connections with family members and/or relatives, while questions 4 to 6 queried connections with friends including neighbors. The response scores of questions Q1 to Q3 and Q4 to Q6 in relation to the numbers of family members and/or relatives, as well as of friends, respectively, were summed according to the following scoring scale: 0 point: 0; 1 point: 1; 2 points: 2; 3 points: 3 or 4; 4 points: 5 to 8; and 5 points: 9 or more.

Table 3. LSNS-6-J questionnaire

Question numbers	Questions
Family members: Considering all of your family members and/or relatives	
1	How many family members and/or relatives do you see or talk to at least once a month?
2	How many family members and/or relatives do you feel comfortable enough to talk to about personal matters?
3	How many family members and/or relatives do you feel close enough to ask for help?
Friendship: Considering all of your friends including neighbors	
4	How many friends do you see or talk to at least once a month?
5	How many friends can you comfortably talk to about personal matters?
6	How many friends do you feel close enough to ask for help?

Note. LSNS-6-J, the Japanese version of the abbreviated Lubben social network scale-6.

2.5 Screening for Depressive Tendency

The geriatric depression scale-15 (GDS-15) for elderly individuals (Sheikh & Yesavage, 1986) was based to prepare the Japanese version (Matsubayashi & Ozawa, 1994). Under the status of emergency declaration due to coronavirus disease 2019 (COVID-19), however, we prepared the GDS-16 by replacing the original question "Do you feel better staying at home rather than going out and doing new things?" with the following 2 questions—questions number 9 and 10: "Did the inability to go out under the state of emergency make you feel stressed?" and "Did the inability to meet with family members and/or relatives, or friends make you feel stressed?" The cutoff for GDS-15-J scores was found to be between 5 and 6 (Watanabe & Imagawa, 2013). However, we considered the presence of depressive tendency when the GDS-16-J score was ≥ 6 points; this procedure remains to be validated. The presence of depression was recognized when the GDS-16-J score was ≥ 12 points. Subjects responded to each

question by selecting either of response choices—“Yes” or “No”; a depressive tendency score of 1 point was allocated to the “yes” choice (Table 4).

Table 4. 16-item depressive tendency questionnaire, a form modified from the GDS-15-J

Question number	Questions	Response choices, points	
		Yes	No
1	Are you satisfied with your daily life?		1
2	Do you think that your daily activities or your interest in surroundings decreased?	1	
3	Do you feel that your life is empty?	1	
4	Do you frequently feel bored every day?	1	
5	Do you live cheerfully most of the time		1
6	Do you frequently have a vague feeling of uneasiness about future?	1	
7	Do you feel that you are happy in most cases?		1
8	Do you frequently feel that you helpless?	1	
9	Did the inability to go out under the state of emergency make you feel stressed under the state of emergency declaration due to COVID-19?	1	
10	Did the inability to meet with family members and/or relatives, or friends make you feel stressed under the state of emergency declaration due to COVID-19?	1	
11	Are you concerned about memory loss above all things?	1	
12	Do you feel wonderful to be alive now?		1
13	Do you occasionally feel that it is not a good idea to be alive?	1	
14	Do you consider yourself vibrant?		1
15	Do you occasionally feel that there is no hope?	1	
16	Do you feel that surrounding people are happier than you?	1	

Note. GDS-15-J, Japanese version of the geriatric depression scale-15; COVID-19, coronavirus disease 2019.

2.6 Multiple Linear Regression Analysis about the Association of Independent Variables with the OFI-8 Scores

Multiple linear regression analysis was made which used a dependent variable (OFI-8 scores) and independent variables (age, gender, the presence or absence of singing habit, social isolation, and depressive tendency/depression). The following scoring scales were applied: for gender, male and female—0 point and 1 point, respectively; for singing habit, presence and absence—1 point and 0 point, respectively; for social isolation, presence (LSNS-6-J score: 0–11 points) and absence (LSNS-6-J score: 12–30 points); and for depressive tendency/depression, presence (modified GDS-16 score: 6–16 points) and absence (modified GDS-16 score: 0–5 points).

2.7 Statistical analyses

Categorical variables were expressed as numbers, means, and percentages. Two-sample t-test was conducted. Pearson’s correlation coefficients were determined and simple linear regression analysis was conducted to assess the association of an independent variable (singing habit scores) with a dependent variable (OFI-8 scores), while multiple linear regression analysis was made to assess the associations of independent variables (age, gender, as well as the presence or absence of singing habit, social isolation, and depressive tendency) with a dependent variable (OFI-8 scores). All statistical analyses were made with the Japanese version of Microsoft 365 Excel (Microsoft, Tokyo, Japan). A value of two-sided $p < 0.05$ was considered statistically significant.

3. Results

3.1 Distributions of the OFI-8 Scores

The OFI-8 scores of 32 subjects ranged from 0 to 11 points (mean score: 3.3 ± 2.3 points; Figure 1). The score of

4 points (8/32 subjects, 25.0%) was most predominant. The mean OFI-8 scores for 6 males and 26 females were 2.0 ± 1.1 points and 3.6 ± 2.5 points, respectively.

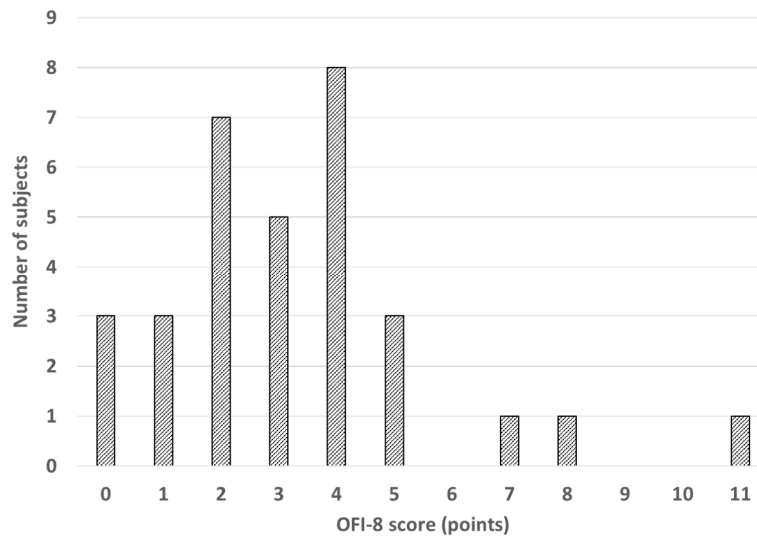


Figure 1. Distributions of the OFI-8 scores (n=32)

Note. OFI, oral frailty index.

3.2 Distributions of the Singing Habit Scores

The signing habit scores of 32 subjects ranged from 1 to 7 points (mean score: 2.7 ± 1.9 points; Figure 2). The score of 1 point—“No habit of signing”—(11/32 subjects, 34.4%) was most predominant, followed by the score of 2 points—“Signing approximately once or twice a month”—(9/32 subjects, 28.1%).

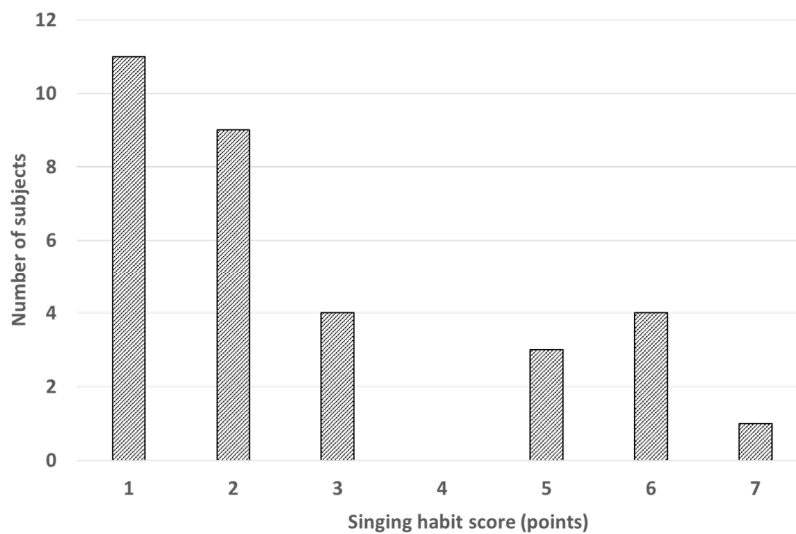


Figure 2. Distributions of the singing habit scores (n=32)

3.3 Association of the Singing Habit Scores with the OFI-8 Scores

Simple linear regression analysis (n=32) revealed that singing habit assessed with its scores (range: 1 to 7 points) significantly lowered the OFI-8 scores ($p=0.045$) although no correlation was detected ($R^2=0.1269$; Figure 3).

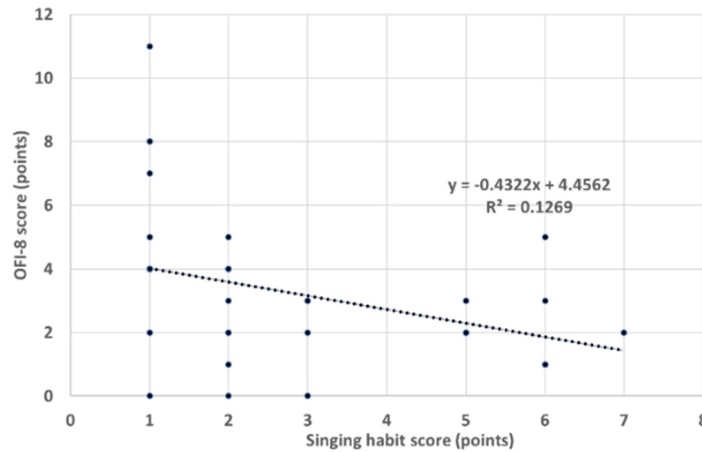


Figure 3. Associations of the singing habit scores with the OFI-8 scores

Note. OFI, oral frailty index.

3.4 Social Isolation Assessed with the LSNS-6-J Scores

The social isolation of 32 subjects was assessed with the LSNS-6-J questionnaire. The LSNS-6-J scores concerning the ties with family members and/or relatives ranged from 0 to 15 points (mean score: 7.8 ± 3.2 points; Figure 4). The lower LSNS-6-J scores indicated weaker social ties with family members and/or relatives. The score of 8 points (6/32 subjects, 18.8%) was most predominant, followed by the score of 9 points (5/32 subjects, 15.6%).

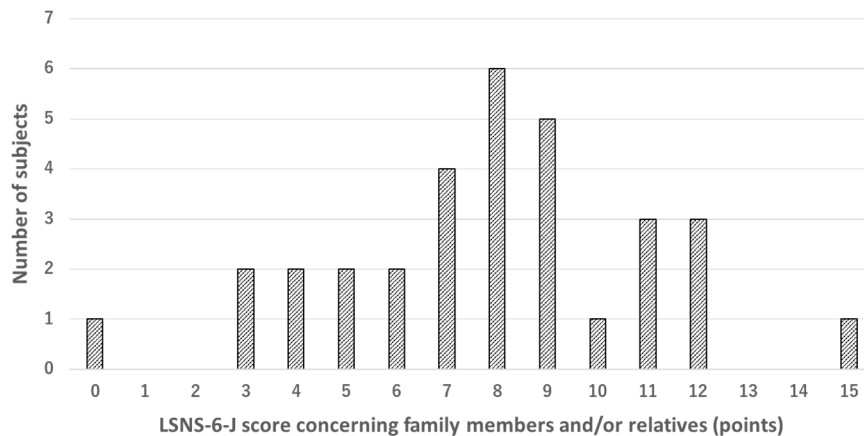


Figure 4. Distributions of the LSNS-6-J scores concerning the ties with family members and/or relatives (n=32)

Note. LSNS-J, Japanese version of the Lubben social network scale.

The LSNS-6-J scores of 32 subjects concerning the ties with friends including neighbors ranged from 0 to 14 points (mean score: 8.1 ± 3.2 points; Figure 5). The score of 9 points (7/32 subjects, 21.9%) was most predominant, followed by the score of 6 points (6/32 subjects, 18.8%).

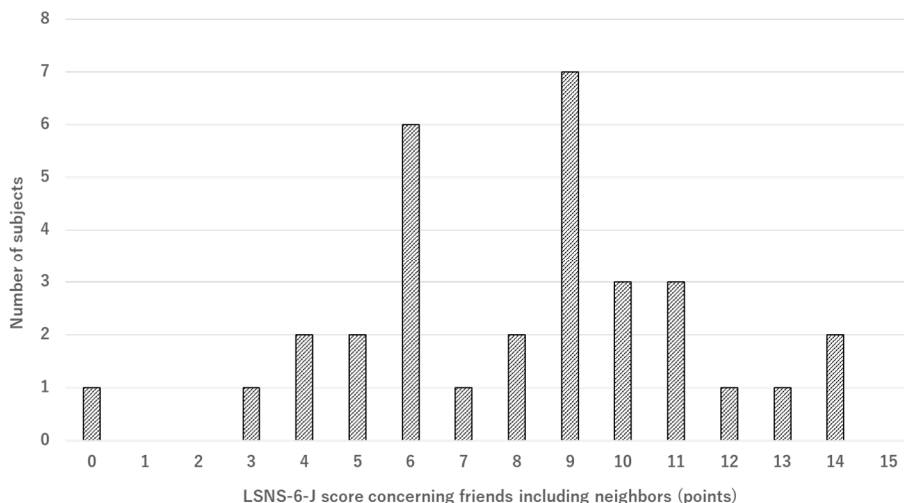


Figure 5. Distributions of the LSNS-6-J scores concerning the ties with friends including neighbors (n=32)
 Note. LSNS-J, Japanese version of the abbreviated Lubben social network scale.

3.5 Depressive Tendency Assessed with the Depression Scores

The depressive tendency scores of 31 subjects ranged from 0 to 14 points (mean score: 4.3 ± 3.9 points; Figure 6). One subject was excluded from the analysis on depressive tendency to due to fault responses. The score of 0 point (6/31 subjects, 19.4%) was most predominant, followed by the scores of 1 and 5 points (4/31 subjects, 12.9% each).

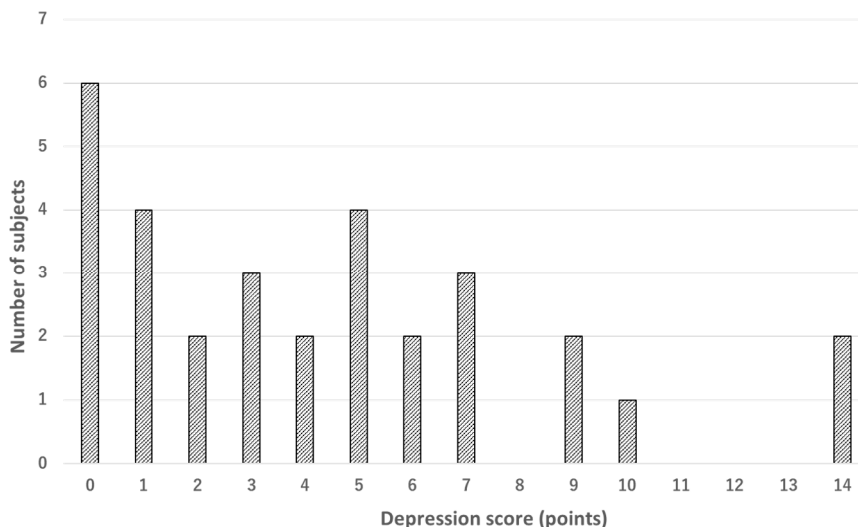


Figure 6. Distributions of the depression scores (n=31)

3.6 Multiple Linear Regression Analysis about the associations of Independent Variables with the OFI-8 Scores

Multiple linear regression analysis (n=31) was made which used the OFI-8 scores as a dependent variable and which used age, as well as the presence or absence of singing habit, social isolation, and depressive tendency as independent variables. The analysis (Table 5) revealed that singing habit showed a moderate inverse correlation ($\beta, -1.73; r=-0.44$) with and significantly lowered the OFI-8 scores ($p=0.03$). Moreover, none of age, social isolation, and depressive tendency were significantly associated with the OFI-8 scores; however, depressive tendency showed a weak correlation with the OFI-8 scores.

Table 5. Multiple linear regression analysis on the OFI-8 scores

Independent variables	Coefficient (β)	Pearson's coefficient (r)	SE	p-value	95% CI
Intercept	-3.95		4.72	0.41	-13.65, 5.75
Age	0.11	0.16	0.07	0.11	-0.25, 0.24
Singing habit (vs. "absence")	-1.73	-0.44	0.75	0.03*	-3.27, -0.18
Social isolation (vs. "absence")	0.63	0.18	0.84	0.46	-1.09, 2.36
Depressive tendency (vs. "absence")	1.63	0.31	0.80	0.05	-0.01, 3.26

OFI, oral frailty index; CI, confidence interval; SE, standard error.

*: < 0.05.

4. Discussion

Poor oral health, swallowing dysfunction, malnutrition, bone frailty, and sarcopenia constitute the features of sarcopenic dysphagia (de Sire et al., 2022). Risk factors for poor oral health have been actively investigated, including poor dental status—number of teeth and denture use (Zhang et al., 2020) and oral hypofunction, a new clinical concept proposed by the Japanese Society of Gerontology in 2016 (Minakuchi et al., 2018)—poor oral hygiene, oral dryness, reduced occlusal force, decreased tongue-lip motor function, decreased tongue pressure, decreased masticatory function, and deterioration of swallowing function (Nakamura et al., 2021).

Based on the finding that one singing session might have an association not only with the oral environment but also with stress relief (Sakano et al., 2014), we established a hypothesis that singing—a complex process of vocalization that requires the complete integration of glossopharyngeal/perioral/mimic muscle motility, saliva secretion, mastication, and deglutition—has some counteracting effects on oral and social frailties.

Previous studies have found the incongruent effects of singing on patients with different disorders. For example, the beneficial effects of singing on respiratory health-related quality of life were found in studies in patients with chronic obstructive pulmonary disease (Bonilha et al., 2009; Lord et al., 2010) but not in others (Donna Goodridge, Nicol, Horvey & Scotty Butcher, 2013). In addition, singing exhibited no beneficial effects on depression or quality of life in patients with Parkinson's disease (Elefant et al., 2012; Shih et al., 2012).

Regarding the associations of repeated singing with oral condition, singing for 4 or 8 weeks increased the secretion of saliva, improved chewing and swallowing, and immune functions, and reduced physiological stress and oxidative stress, suggesting that singing habit can improve the mental health and oral condition of the elderly (Sakano et al., 2018). To our knowledge, however, we are the first to have investigated the associations of singing habit with oral frailty by assessing the OFI-8 scores.

Elderly individuals with a high level of social isolation had the increased risk of becoming frail (Gale, Westbury & Cooper, 2018). A significant association between eating alone and oral frailty was detected in community-dwelling Japanese older adults (Ohara et al., 2020). A decline in social function, which is one of known frailty-related factors such as a decline in physical function, decreased nutritional status, and an increased number of medications used (Makizako et al., 2019), may contribute to oral and physical frailties (Hironaka et al., 2020). However, social isolation was almost unrelated to oral frailty in the present study, which is not in line with the abovementioned findings. The possibility that the use of not the original 10-item but short form 6-item LSNS had some impact on this result is undeniable.

Older adults with oral frailty are at higher risk of developing depression than are their counterparts (Tanaka et al., 2021). Our data indicated a weak association of depressive tendency with oral frailty, supporting a significant association of physical and oral frailty with late-life depression in community-dwelling older adults (Lin et al., 2022). Lonely people are more likely to be inactive, thus increasing the risk of physical frailty (Gale, Westbury & Cooper, 2018; Peterson et al., 2009; Song et al., 2015). Oral frailty, social frailty, and physical frailties were found to be mutually related in elderly individuals (Hironaka et al., 2020), and regular participation in community level choirs can reduce anxiety, depression, and loneliness (Pentikainen et al., 2021). Unfortunately, the present study did not provide any data to assess the association between depressive tendency and physical frailty. Therefore, another more detailed study concerning the associations of singing profiles (e.g., solo/group singing habit, duration of each singing session/singing habit, singing environment, and song categories) with social frailty warrants to be conducted.

This study has several limitations. First, sample size was relatively small and can be increased by extending the recruitment period and/or by raising the number of recruiting divisions of our university. Second, the marked numerical disproportionality of male and female genders precluded us from conducting the multiple regression analysis on gender. Therefore, another study enrolling the nearly equal numbers of male and female individuals will be required to allow for the analysis. Third, this study enrolled only middle-aged and elderly individuals who agreed to participate in questionnaire surveys, which involved an undeniable selection bias and the limited generalization of the findings. The bias is less likely to occur when adopting an interview survey—an approach that is more active and that can more precisely collect information than the self-reported questionnaire survey.

5. Conclusion

The present exploratory study does not provide conclusive evidence about oral frailty prevention by singing habit but affords underpinnings for further research. A future interview survey concerning the associations of singing habit with oral frailty, which successfully recruited nearly equal numbers of male and female healthy individuals, might provide more robust scientific evidence on the associations and might demonstrate the contributions of singing habit-improved oral frailty and frailty to healthy life extension.

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Data Availability Statement

The data that support the findings of this study are available on request.

Competing Interests Statement

The authors declare no competing or potential conflicts of interest.

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