



Relationship Between Tongue Strength and Dysphagia Symptoms in Japanese Older Adults in Need of Care

Morisaki Naoko^{1*}

¹Himeji University, School of Nursing, Japan

Corresponding Author: **Morisaki Naoko** [ORCID ID](#)

Address: Himeji University, School of Nursing, 2042-2 Oshio, Himeji, Hyogo 671-0101, Japan;

E-Mail: naoko_morisaki@koutoku.ac.jp

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Abstract

Purpose: The purpose of this study was to measure the tongue pressure of older adults who require nursing care and to clarify the relationship between dysphagia symptoms and tongue strength.

Methods: The participants were Japanese older adults (age: ≥ 65 years) in need of care who were able to communicate with others and agreed to participate in the study. Tongue pressure was measured using TPM-01, a tongue pressure measuring instrument. The Dysphagia Risk Assessment for Community-Dwelling Elderly was used to assess dysphagia. The association between tongue pressure and 12 dysphagia symptoms was analyzed using a one-way analysis of variance.

Results: The average tongue pressure was 23.22 ± 9.9 kPa. Tongue pressure was significantly associated with occasional food spillage from the mouth and sputum formation in the throat during meals or after eating or drinking ($p < 0.05$).

Conclusions: Decreased tongue strength should be suspected in older adults with food spillage from the mouth or sputum formation in the throat during meals.

Keywords

Tongue Pressure, Dysphagia, Older Adults in Need of Care, Japan

Background

The oral function is important for extending healthy life expectancy, and there has been an increasing amount of research on this topic. Oral functions include speech, swallowing, and respiration, of which swallowing is extremely important because it is essential for obtaining nourishment. The phases of swallowing have oral, pharyngeal, and esophageal. Swallowing refers to the process of orally consuming food, chewing it, swallowing it, and transporting it to the stomach [1,2]. Impaired swallowing function has

been reported to be particularly common in older adults who require nursing care [3,4].

The process of swallowing involves the activity of multiple organs and muscle groups, one of which is the tongue. The tongue is responsible for shaping food in the mouth into a form that can be easily swallowed, moving it from the mouth to the pharynx. Tongue strength is an important determinant of swallowing function. However, many older adults who require nursing care have decreased tongue strength [5].

Tongue strength is assessed by tongue pressure. Decreased tongue pressure has been reported to be associated with signs of dysphagia [6], suggesting that decreased tongue strength may impair swallowing.

Therefore, the purpose of this study was to measure the tongue pressure of older adults who require nursing care and to clarify the relationship between dysphagia symptoms and tongue strength.

Methods

Participants:

The participants were Japanese older adults (age: \geq 65 years) in need of care who were able to communicate with others and agreed to participate in the study. Many of Japanese older adults in need of care use day care services. Therefore, I asked the older adults who use six-day service centers in Hyogo prefecture to cooperate in this study.

Study outcomes:

Tongue Pressure:

Tongue pressure was measured using TPM-01, a tongue pressure measuring instrument (JMS Co., Ltd., Hiroshima, Japan) that comprises a digital tongue pressure meter, connecting tube, and tongue pressure probe. The balloon of the tongue pressure probe was automatically pressurized to a predetermined level (20 kPa) by the measurement device and placed on the oral part of the tongue while the participants were seated. The participants were then instructed to exert the maximum possible force to elevate the tip of their tongue to the palate for 5–7 s, during which the intensity of the force required to compress the balloon was measured. Two consecutive measurements were performed in accordance with the method described in previous studies [7], and the mean of the measured values was recorded as the tongue pressure level (in kPa).

Dysphagia Symptoms:

The Dysphagia Risk Assessment for Community-Dwelling Elderly [8] was used to assess dysphagia. It is a twelve-item questionnaire developed to assess the risk of dysphagia in older adults. The questionnaire includes well-balanced items that cover all phases of swallowing. The 12 items are as follows: “Do you

sometimes have a fever?,” “Do you feel as though having a meal is more time-consuming than before?,” “Do you sometimes feel as though swallowing is difficult?,” “Do you sometimes feel as though it is difficult to eat something hard?,” “Does food sometimes spill out of your mouth?,” “Do you sometimes choke during your meals?,” “Do you sometimes choke when you drink liquid such as tea?,” “Are there times when the things you swallowed flow back into your nose?,” “Does your voice sometimes change after eating or drinking?,” “Does sputum form in your throat during meals or after eating or drinking?,” “Do you sometimes feel as though food gets stuck in your chest?,” and “Are there times when food or a sour fluid flows back from your stomach toward your throat?.” The participants were asked to report the frequency of occurrence of these symptoms, and the options provided were “often,” “sometimes,” and “never.” Responses were obtained through participant interview or self-administration.

Statistical Analysis:

The association between tongue pressure and 12 dysphagia symptoms was analyzed using one-way analysis of variance. Tukey tests were then performed on variables that showed statistical significant differences. The significance level was set at $p < 0.05$. IBM SPSS Ver. 26.0 (SPSS, Inc., Tokyo, Japan) was used for the statistical analyses.

Ethical Considerations:

The outline of the research, voluntary nature of participation, anonymity, and agreement regarding the publication of results were explained to the participants both in writing and verbally, and their consent was subsequently obtained. The study was approved by the Research Ethics Review Committee of the School of Nursing at Himeji University.

Results

Participants’ Characteristics:

The average age of the participants was 81.7 ± 7.2 years. There were 103 (36.4%) men and 180 (63.6%) women. A total of 195 (68.9%) lived in their own homes, while 88 (31.1%) lived in nursing homes.

Tongue Pressure:

The distribution of the participants' tongue pressure is shown in Fig-1. The average tongue pressure was 23.22 ± 9.9 kPa.

Dysphagia Symptoms:

The frequency of occurrence of dysphagia symptoms is shown in Table-1. The commonly occurring

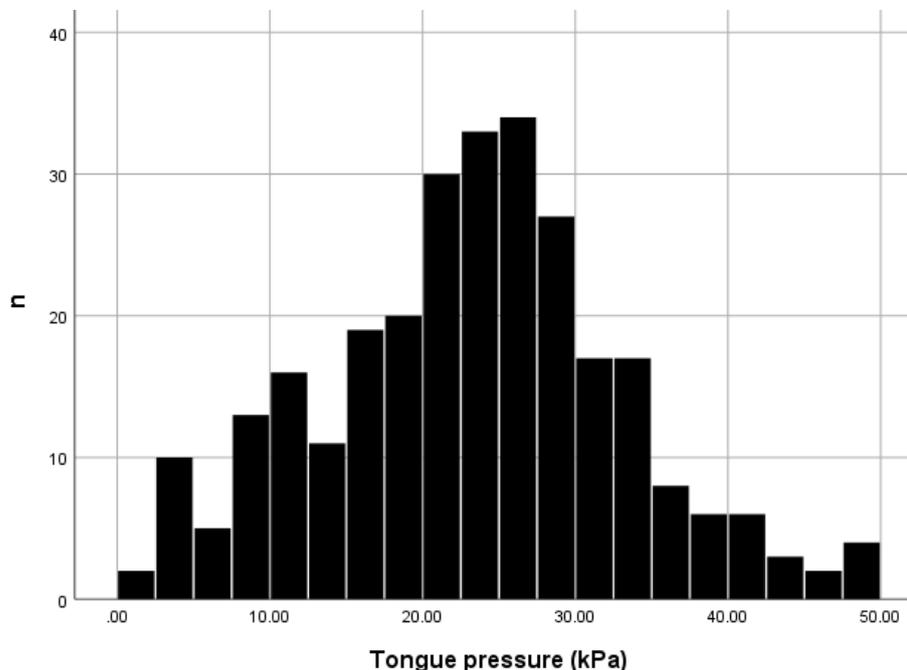


Fig-1: Distribution of tongue pressure (N = 283)

Table-1: Frequency of occurrence of dysphagia symptoms (N = 283)

Dysphagia symptoms	n (%)		
	Never	Sometimes	Often
1. Do you sometimes have a fever?	232 (82.0)	48 (17.0)	3 (1.1)
2. Do you feel as though having a meal is more time-consuming than before?	173 (61.1)	89 (31.4)	21 (7.4)
3. Do you sometimes feel as though swallowing is difficult?	209 (73.9)	65 (23.0)	9 (3.2)
4. Do you sometimes feel as though it is difficult to eat something hard?	139 (49.1)	106 (37.5)	38 (13.4)
5. Does food sometimes spill out of your mouth?	185 (65.4)	83 (29.3)	15 (5.3)
6. Do you sometimes choke during your meals?	165 (58.5)	109 (38.5)	9 (3.2)
7. Do you sometimes choke when you drink liquid such as tea?	169 (59.7)	106 (37.3)	8 (2.8)
8. Are there times when the things you swallowed flow back into your nose?	259 (91.5)	23 (8.1)	1 (0.4)
9. Does your voice sometimes change after eating or drinking?	255 (90.1)	25 (8.8)	3 (1.1)
10. Does sputum form in your throat during meals or after eating or drinking?	208 (73.5)	63 (22.3)	12 (4.2)
11. Do you sometimes feel as though food gets stuck in your chest?	211 (74.6)	62 (21.9)	10 (3.5)
12. Are there times when food or a sour fluid flows back from your stomach toward your throat?	214 (75.3)	66 (23.3)	4 (1.4)

dysphagia symptoms were feeling as though it is difficult to eat something hard, choking during meals, choking while drinking liquids, and feeling as though having a meal is more time-consuming than it used to be.

Association Between Tongue Pressure and Dysphagia Symptoms:

The results of the analysis of the association between tongue pressure and 12 dysphagia symptoms

are presented in **Table-2**. Tongue pressure was significantly associated with occasional food spillage from the mouth and sputum formation in the throat during meals or after eating or drinking ($p < 0.05$). The results of the further analysis of the two variables that showed significant differences are presented in **Table-3**. Participants whose answer to these two questions was “Often” had a significantly lower tongue pressure than those who answered “Never” or “Sometimes” ($p < 0.05$).

Table-2: Association between tongue pressure and dysphagia symptoms (N = 283)

Dysphagia symptoms	p
1. Do you sometimes have a fever?	0.37
2. Do you feel as though having a meal is more time-consuming than before?	0.75
3. Do you sometimes feel as though swallowing is difficult?	0.92
4. Do you sometimes feel as though it is difficult to eat something hard?	0.95
5. Does food sometimes spill out of your mouth?	.02*
6. Do you sometimes choke during your meals?	0.57
7. Do you sometimes choke when you drink liquid such as tea?	0.23
8. Are there times when the things you swallowed flow back into your nose?	0.72
9. Does your voice sometimes change after eating or drinking?	0.33
10. Does sputum form in your throat during meals or after eating or drinking?	.01*
11. Do you sometimes feel as though food gets stuck in your chest?	0.53
12. Are there times when food or a sour fluid flows back from your stomach toward your throat?	0.52

- One-way analysis of variance
- *: $p < 0.05$

Table-3: Association between tongue pressure and dysphagia symptoms showing significant differences in the one-way analysis of variance (N = 283)

Dysphagia symptoms [tongue pressure: kPa]	SEM	p
Food sometimes spills out of the mouth		
Often [16.64]	Never [23.20]	0.04
	Sometimes [24.50]	0.01
Sputum forms in the throat during meals or after eating or drinking		
Often [15.24]	Never [23.81]	0.01
	Sometimes [22.83]	0.04

- SEM: standard error of mean
- Tukey test
 - *: $p < 0.05$

Discussion

This study revealed that older adults with weak tongues are more likely to spill food from their mouths and to have sputum form in their throats while eating than those with strong tongues.

Under normal conditions, food does not spill from the mouth. This is because once it is placed in the mouth, it travels from the oral cavity to the pharynx. Several factors may cause food to spill from the mouth, including inadequate lip closure and cheek muscle weakness; however, tongue movement is considered an important factor. The tongue plays an important role in swallowing by collecting and transporting the food bolus from the oral cavity to the pharynx [9]. Because of its anatomical characteristics, the tongue can perform various movements to move the bolus anteriorly and laterally and generate pressure to propel the bolus posteriorly [10]. Bolus propulsion during the oral phase of swallowing has been thought to be characterized by sequential elevation of the anterior, middle, and posterior portions of the dorsum of the tongue. The tongue undergoes rapid changes in shape during swallowing to transport the bolus from the oral cavity to the pharynx, and there is a great deal of individual variation in this process [11]. Tongue movement slows with age, and the causes of age-related changes in tongue movement include muscle weakness and shape changes [12]. Although we did not evaluate the shape of the tongue in this study, we believe that decreased tongue strength leads to impaired transport of food into the pharynx, which in turn causes food to spill from the mouth. Weakness of the muscles involved in swallowing also causes retention of food in the throat, resulting in a kind of sputum formation. The pressure required to swallow food is generated through tongue movement, and it is thought that a decrease in tongue pressure results in inadequate swallowing. Although dysphagia symptoms in this study were subjectively assessed, the results of this study are consistent with those of previous studies on tongue function [13,14], and decreased tongue strength should be suspected in older adults with food spillage from the mouth or sputum formation in the throat during meals.

Conclusion

Tongue pressure was associated with food spillage from the mouth and sputum formation in the throat during meals or after eating or drinking.

Conflict of Interest

The author has read and approved the final version of the manuscript. The author has no conflicts of interest to declare.

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