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Original Article

# Effects of oral exercise on tongue pressure in Taiwanese older adults in community day care centers

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Received 29 September 2021; Final revision received 27 October 2021

Available online 27 November 2021

## KEYWORDS

Tongue pressure;  
Oral exercise;  
Older adults;  
Functional tooth units

**Abstract** *Background/purpose:* Oral exercise is a training method for swallowing dysfunction in older adults. The study investigated the effect of oral exercise on tongue pressure in older adults in Taiwanese community day care centers over a 3-month period.

*Materials and methods:* Participants over age 50 who were able to communicate and participating for the duration of the 12-week period were recruited from five community day care centers. A 15-min weekly group oral exercise activity was conducted. The tongue pressures were measured and multivariable linear regression models were used to assess the effect of oral exercise intervention on the participants' tongue pressures.

*Results:* A total of 66 older adult participants, among whom the mean age was  $78.06 \pm 10.74$  years. Tongue pressure continued improving during the intervention period, and the mean tongue pressure at the end of the study was  $20.63 \pm 10.45$  kPa, which was significantly higher than the baseline measurement ( $16.92 \pm 10.62$  kPa,  $p < 0.001$ ). Participants exhibited significant improvement in tongue pressure regardless of their age groups. Moreover, participants with one to seven pairs of functional tooth units (FTUs) exhibited significantly more improvement in tongue pressure ( $16.00$  kPa, 95% CI = 2.58–29.43) than those without FTUs ( $p = 0.021$ ).

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<https://doi.org/10.1016/j.jds.2021.10.017>

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**Conclusion:** Oral exercise over a 3-month period significantly improved tongue pressure among the study participants regardless of their gender or age group. Oral exercise should be integrated into comprehensive health promotion programs to assist in the improvement and maintenance of oral function among older adults.

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## Introduction

Poor oral health is associated with major systemic diseases, such as cardiovascular disease and pneumonia, and even mortality, especially in older adults.<sup>1</sup> In addition to dental caries and periodontal disease, loss of swallowing function is a key oral health concern. With aging, masticatory and swallowing muscles can atrophy, leading to swallowing dysfunction.<sup>2</sup> Without proper swallowing function, an individual may be forced to alter their diet, thereby limiting their intake of essential nutrients and increasing their risk of malnutrition.<sup>3,4</sup> In addition, impaired chewing function may be associated with cognitive impairment, dementia, and aspiration pneumonia.<sup>5–7</sup>

Three methods are used for evaluating swallowing dysfunction: trial swallows, videofluoroscopic swallowing studies, and tongue pressure measurement. Tongue pressure measurement has received greater attention over the last decade because it is a simple and noninvasive method that can be repeatedly administered.<sup>8,9</sup> In 2018, it became one of the standard indices of oral frailty defined by the Japanese Society of Gerodontology.<sup>10</sup>

In addition to surgery and medication, several other methods can be used to alleviate or prevent swallowing dysfunction, including dietary modification and muscle training.<sup>11,12</sup> Oral exercise is another physical training method for this purpose and can be used by older adults in community day care centers or other long-term care institutions. It comprises exercises for the tongue, salivary glands, and muscles controlling facial expression and swallowing.<sup>13,14</sup> According to Ibayashi et al.,’s 2008 study, which involved 26 healthy older adult participants and was conducted over 6 months, older adults who participated in oral exercise exhibited significant improvements in oral functions including bite force, swallowing ability, and salivary flow rate, whereas no improvement was observed in the control group.<sup>15</sup> In Raj et al.,’s 2020 study, 48 healthy older adults were recruited for an oral exercise program; after just 15 days, participants reported alleviated dry mouth symptoms, and exhibited improvement in salivary secretion and other oral functions.<sup>16</sup> Although oral exercise has been found to improve oral function, research on the effect of oral exercise on older adults with weak tongue pressure has been insufficient. Therefore, this study investigated the effect of oral exercise over a 3-month period on older adults with weak tongue pressure in Taiwanese community day care centers.

## Materials and methods

### Study population

In this prospective cohort study, purposive sampling was used to select participants from five community day care centers. Adults who aged over 50, having a tongue pressure under 20 kPa but no swallowing difficulties or complaints, able to communicate, and capable of participating in a 12-week oral exercise and tongue pressure measurement program, were invited to participate.<sup>8,17,18</sup> In the Japanese Society of Gerodontology suggestion tongue pressure should surpass 20 kPa to be sufficient for oral function.<sup>10</sup> The study was approved by the Institutional Review Board of National Yang Ming University (approval number: YM106069F), and informed consent was obtained from all participants.

### Oral exercise intervention

The oral exercise program included deep breathing, the neck, shoulder, front-to-back and top-to-bottom upper limb region movements, tongue area motion, lip opening and closing motions, cheek inflation and deflation, vocal exercising, salivary gland massage. The vocal exercise for the syllables “pa-ta-ka-la”, which improves the functions of the tongue, lips, pharynx, and larynx, and also prevents dysarthria and aspiration in older adults.<sup>19,20</sup> During the 3-month intervention period, a weekly group activity of approximately 15 min was conducted for the participants at lunch time.

### Tongue pressure measurement, oral examination, and questionnaire

Two dentists conducted baseline oral examinations using community periodontal index probes. Dental caries was diagnosed at the cavitation level through visual–tactile examinations without radiographs followed by the calculation of an index of dental caries experience, specifically the Decayed, Missing, and Filled Teeth (DMFT) index. The number of functional tooth units (FTUs), dry mouth symptoms, and dentures were also included in a participant’s oral health status. In addition, a structured questionnaire, administered by the participants’ caregivers or the participants themselves, was used to collect information on gender, age, body mass index, mental status (as assessed

using the short portable mental status questionnaire), and dependency status.

A tongue pressure measurement device (JMS TPM-01) was used to evaluate the effect of the oral exercise during the intervention period. Each participants placed a balloon type probe in their oral cavity and was asked to push the tip of their tongue against their hard palate using the maximum possible pressure for 7 s.<sup>21</sup> The pressure of the tip of the tongue corresponded to the tongue pressure. The mean value of three measurements was used for analysis.

### Statistical analysis

During the intervention period, the participants' tongue pressures were measured four times: at baseline and at the 4th, 8th, and 12th weeks. The differences among participants' demographic characteristics, oral health status, tongue pressure measurements at baseline versus at the end of the study, and changes in tongue pressure were analyzed using a Student *t* test and analysis of variance tests; Scheffé tests were used for *post hoc* multiple comparisons. Multivariable linear regression models were used to estimate the effects of oral exercise intervention, demographic characteristics, and oral health status on participants' tongue pressure measurements at baseline and at the end of the study and on the change between the two measurements. All statistical tests were performed using

SPSS software (IBM SPSS Statistics for Windows, version 24.0; IBM, Armonk, NY, USA), and a *p* value < 0.05 was considered statistically significant (two-tailed).

### Results

A total of 66 older participants, with a mean age of  $78.06 \pm 10.74$  years, fully completed the 12-week intervention. As indicated in Table 1 and Table 2, 43.9% of the participants were aged 80–89 years and 30.3% were aged 70–79 years. Nearly 80% were female. More than 80% were independent and capable of self-care. Regarding participants' oral health status, the mean DMFT index  $\pm$ SD was  $21.58 \pm 7.42$ ; 45.4% of the participants wore dentures; 75.7% had eight or more FTUs; 24.2% of them experienced self-reported dry mouth symptoms.

As indicated in Fig. 1, the mean  $\pm$  SD tongue pressure at baseline was  $16.92 \pm 10.62$  kPa and it continued improving during the intervention period. The mean values at the 8th week ( $19.10 \pm 10.49$  kPa) and the 12th week ( $20.63 \pm 10.45$  kPa) were significantly higher than the mean value at baseline ( $p = 0.015$  and  $p < 0.001$ , respectively).

As indicated in Table 1, at baseline, the mean  $\pm$  SD tongue pressure of the participants aged 50–59 years was  $30.00 \pm 11.36$  kPa, which was significantly higher than that of all other age groups (All *p* values < 0.05 in Scheffé *post hoc* tests). Tongue pressure generally decreased with age.

**Table 1** General characteristics and tongue pressure measurements at baseline and at 12 weeks (N = 66).

General characteristics	N (%)	Mean tongue pressure (SD)		
		Baseline	End of the study	Amount of change
<b>Total</b>	66 (100.0)	16.92 (10.62)	20.63 (10.45)	3.70 (8.09)
<b>Gender</b>				
Female	14 (78.8)	16.79 (11.07)	20.01 (12.05)	3.22 (5.47)
Male	52 (21.2)	16.96 (10.60)	20.79 (10.10)	3.83 (8.70)
<b>Age group</b>				
50–59	6 (9.1)	30.00 (11.36) <sup>a</sup>	35.27 (9.06) <sup>c</sup>	5.27 (3.03)
60–69	4 (6.1)	19.76 (7.38) <sup>b</sup>	26.46 (7.62) <sup>c</sup>	6.70 (8.81)
70–79	20 (30.3)	15.01 (10.46) <sup>b</sup>	21.27 (9.59) <sup>c</sup>	6.71 (9.50)
80–89	29 (43.9)	16.08 (8.90) <sup>b</sup>	16.68 (8.90) <sup>d</sup>	0.60 (6.51)
≥90	7 (10.6)	13.05 (9.79) <sup>b</sup>	17.98 (9.98) <sup>d</sup>	4.92 (9.60)
<b>BMI</b>				
Underweight	21 (31.8)	18.18 (8.78)	22.82 (9.29)	4.65 (4.22)
Healthy weight	42 (63.6)	16.32 (11.82)	19.54 (11.20)	3.22 (9.61)
Overweight	3 (4.6)	16.56 (1.84)	20.47 (5.93)	3.91 (6.33)
<b>SPMSQ</b>				
Normal	39 (59.1)	17.63 (10.84)	22.30 (10.02)	4.67 (7.06)
Mild	12 (18.2)	18.85 (10.06)	19.88 (11.77)	1.03 (12.09)
Moderate	8 (12.1)	14.58 (11.00)	17.18 (9.77)	3.20 (6.57)
Severe	7 (10.6)	12.39 (10.41)	15.86 (11.16)	3.47 (7.32)
<b>Dependence</b>				
Self-care	55 (83.3)	18.21 (10.71) <sup>e</sup>	21.45 (10.16)	3.24 (8.42)
Need help	11 (16.7)	10.49 (7.67) <sup>f</sup>	16.52 (11.40)	6.02 (5.93)

Standard Deviation (SD); The body mass index (BMI); The body mass index <22.9 kg/m<sup>2</sup> (Underweight); The body mass index 23–30.9 kg/m<sup>2</sup> (Healthy weight); The body mass index >31 kg/m<sup>2</sup> (Over weight); The short portable mental status questionnaire (SPMSQ); SPMSQ 0–2 errors: mental functioning (Normal); SPMSQ 3–4 errors: cognitive impairment (Mild); SPMSQ 5–7 errors: cognitive impairment (Moderate); SPMSQ 8 or more errors: cognitive impairment (Severe); The ability of self-care (Dependence).

¶ Values with the same superscript letter indicate that there are no significant differences ( $p > 0.05$ ).

**Table 2** Oral health status and tongue pressure measurements at baseline and 12 weeks (N = 66).

Oral health statuses	N (%)	Mean tongue pressure (SD)		
		Baseline	End of the study	Amount of change
<b>DT index</b>				
≤10	64 (97.0)	17.11 (10.73)	20.48 (10.54)	3.37 (7.90)
≥11	2 (3.0)	10.82 (1.72)	25.20 (7.54)	14.38 (9.26)
<b>MT index</b>				
≤10	54 (81.8)	18.34 (9.80) <sup>b</sup>	22.17 (10.10) <sup>d</sup>	3.83 (8.09)
≥11	9 (13.6)	7.99 (11.50) <sup>a</sup>	11.81 (9.01) <sup>c</sup>	3.83 (9.35)
Edentulous	3 (4.6)	18.28 (13.19) <sup>b</sup>	19.36 (10.19) <sup>d</sup>	1.08 (5.41)
<b>FT index</b>				
≤10	27 (40.9)	18.19 (12.28)	21.25 (11.35)	3.06 (7.52)
≥11	39 (59.1)	16.05 (9.37)	20.19 (9.90)	4.15 (8.52)
<b>Denture</b>				
No	36 (54.6)	18.87 (11.33)	22.29 (10.77)	3.41 (6.76)
Yes	30 (45.4)	14.58 (9.35)	18.63 (9.86)	4.05 (9.55)
<b>FTUs</b>				
0 pairs	11 (16.7)	12.79 (11.84)	14.55 (9.03) <sup>f</sup>	1.76 (6.48) <sup>h</sup>
1–7 pairs	5 (7.6)	10.21 (6.07)	20.96 (11.77) <sup>f</sup>	10.75 (8.10) <sup>g</sup>
≥8 pairs	50 (75.7)	18.50 (10.34)	21.93 (8.18) <sup>e</sup>	3.43 (8.18) <sup>h</sup>
<b>Dry mouth</b>				
No	50 (75.8)	16.46 (10.64)	20.69 (11.10)	4.24 (7.74)
Yes	16 (24.2)	18.38 (10.75)	20.42 (8.39)	2.04 (9.15)

Standard Deviation (SD); Decayed teeth (DT); Missing teeth (MT); Filled teeth (FT); removable partial denture or complete denture (Denture); The number of functional tooth units (FTUs).

¶ Values with the same superscript letter indicate that there are no significant differences ( $p > 0.05$ ).

The mean tongue pressure of participants who were capable of self-care was  $18.21 \pm 10.71$  kPa, which was significantly higher than that of the participants who were dependent ( $10.49 \pm 7.67$  kPa,  $p = 0.011$ ). At the end of the study, tongue pressure was still observed to generally decrease with age. The tongue pressure of the participants aged 50–59 ( $35.27 \pm 9.06$  kPa), 60–69 ( $26.46 \pm 7.62$  kPa), and 70–79 ( $21.27 \pm 9.59$  kPa) years were all significantly higher than those of participants aged 80–89 ( $16.68 \pm 8.90$  kPa) or  $\geq 90$  ( $17.98 \pm 9.98$  kPa) years ( $p$  values  $< 0.05$  in Scheffé *post hoc* tests). All age groups except the 80–89-year-old group exhibited a 4.92–6.71 kPa improvement in tongue pressure.

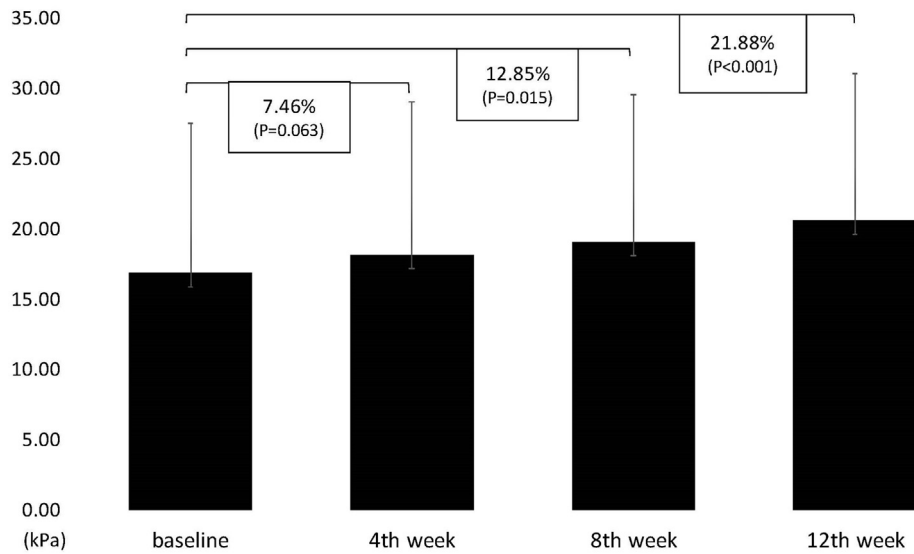
Participants with more than 11 missing teeth had significantly lower tongue pressure ( $7.99 \pm 11.50$  kPa at baseline,  $11.81 \pm 9.01$  kPa at the end of the study) than those with fewer than 10 missing teeth ( $18.34 \pm 9.80$  kPa at baseline,  $22.17 \pm 10.10$  kPa at the end of the study;  $p = 0.023$  and  $0.020$ , respectively), as indicated in Table 2. Moreover, at the end of the study, participants with more than 1 FTU had significantly higher tongue pressure ( $20.96 \pm 11.77$  kPa for those with one to seven pairs,  $21.93 \pm 8.18$  kPa for those with more than eight pairs) than those without FTUs ( $14.55 \pm 9.03$  kPa,  $p = 0.031$ ).

Table 3 displays the results of the multivariate linear regression analyses conducted to identify factors associated with the participants' baseline and 12-week tongue pressure measurements and the change between the two measurements. Participants with more than 11 decayed teeth exhibited significantly more improvement of tongue pressure (13.92 kPa, 95% CI = 0.20–27.64) than those with fewer than 10 decayed teeth ( $p = 0.047$ ) after potential

confounding factors those listed on Table 3 were adjusted for. Participants with one to seven pairs of FTUs exhibited significantly more improvement of tongue pressure (16.00 kPa, 95% CI = 2.58–29.43) than those without FTUs ( $p = 0.021$ ). However, participants with eight or more pairs of FTUs did not exhibit significantly more improvement of tongue pressure (9.30 kPa, 95% CI = –2.88–21.48) than those without FTUs ( $p = 0.131$ ). In summary, a 3-month oral exercise program can exert a positive effect and improving on the tongue pressure of older people. Moreover, the effect is especially significant among older adults with one to seven pairs of FTUs.

## Discussion

In this prospective cohort study, the study team recruited 66 older adult participants, guided them through a weekly oral exercise program, and monitored the changes in their tongue pressure. After the 3-month intervention period, changes in the participants' tongue pressure measurements indicated that oral exercise can have a positive effect on participants' tongue pressure regardless of gender or age. Swallowing is a complicated function that involves forcing the tongue to touch the front of the upper jaw, then transporting the food bolus backwards, and finally squeezing the tongue against the entire upper palate to send the food bolus into the pharyngeal cavity. If any of the contact patterns involved are obstructed, difficulty in swallowing could occur, leading to coughing and even aspiration pneumonia (a major health problem for older adults).<sup>22–24</sup> Tongue pressure is not only a predictor of



**Figure 1** Mean tongue pressure of participants during oral exercise intervention (kPa: kilopascal). The tongue pressure at baseline was 16.92 kPa after 4 weeks oral exercise intervention increase to 18.19 kPa (7.46%) and it continued improving during the intervention period and significantly higher than the mean value at baseline ( $p = 0.063$ ,  $0.015$  and  $p < 0.001$ , respectively).

**Table 3** Results of the multivariate linear regression analyses conducted to identify factors associated with baseline and 12-week tongue pressure measurements and change between them.

Variables	Baseline		End of the study		Amount of change		
	Beta	95% CI	Beta	95% CI	Beta	95% CI	
<b>General characteristics</b>							
<b>Gender</b>	Male vs female	0.55	-6.07-7.17	1.15	-4.89-7.19	0.60	-4.87-6.07
<b>Age group</b>	60-69 vs 50-59	-12.11	-26.12-1.90	-8.55	-21.32-4.22	3.56	-8.01-15.13
	70-79 vs 50-59	-11.56	-21.95-1.18*	-9.96	-19.42-0.49*	1.61	-6.97-10.18
	80-89 vs 50-59	-12.74	-22.69-2.79*	-17.58	-26.66-8.51*	-4.84	-13.06-3.38
	$\geq 90$ vs 50-59	-15.04	-28.37-1.71*	-15.97	-28.11-3.82*	-0.93	-11.93-10.08
<b>BMI</b>	Under vs healthy	-2.12	-8.12-3.88	-1.87	-7.34-3.61	0.25	-4.70-5.21
	Over vs healthy	-3.77	-16.86-9.31	-6.37	-18.29-5.56	-2.59	-13.40-8.21
<b>SPMSQ</b>	Mild vs normal	0.14	-6.49-6.77	-1.86	-7.90-4.19	-2.00	-7.47-3.48
	Moderate vs normal	-0.28	-8.87-8.30	0.94	-6.89-8.76	1.22	-5.87-8.31
	Sever vs normal	-2.10	-13.28-9.09	-6.21	-16.40-3.98	-4.11	-13.35-5.12
<b>Dependence</b>	Need help vs self-care	-6.04	-14.07-1.99	-6.39	-13.71-0.93	-0.35	-6.98-6.28
<b>Oral health status</b>							
<b>DT index</b>	$\geq 11$ vs $\leq 10$	3.24	-13.38-19.86	17.16	2.01-32.03*	13.92	0.20-27.64*
<b>MT index</b>	$\geq 11$ vs $\leq 10$	-19.98	-34.88-5.07*	-12.75	-26.33-0.84	7.23	-5.08-19.54
	Edentulous vs $\leq 10$	-10.63	-31.31-10.04	-0.10	-18.94-18.75	10.54	-6.54-27.61
<b>FT index</b>	$\geq 11$ vs $\leq 10$	-2.91	-12.09-6.27	-1.05	-9.41-7.32	1.86	-5.72-9.44
<b>Denture</b>	Yes vs no	-2.90	-11.41-5.60	-2.44	-10.20-5.31	0.46	-6.57-7.48
<b>FTUs</b>	1-7 pairs vs 0 pairs	-12.04	-28.30-4.22	3.96	-10.86-18.78	16.00	2.58-29.43*
	$\geq 8$ pairs vs 0 pairs	-9.09	-23.84-5.66	0.21	-13.24-13.65	9.30	-2.88-21.48
<b>Dry mouth</b>	Yes vs no	7.31	0.94-13.67*	3.98	-1.82-9.78	-3.32	-8.58-1.93

The body mass index (BMI); the short portable mental status questionnaire (SPMSQ); the ability of self-care (Dependence); Decayed teeth (DT); Missing teeth (MT); Filled teeth (FT); removable partial denture or complete denture (Denture); The number of functional tooth units (FTUs).

All models were adjusted for age group, gender, BMI, SPMSQ, Participants' dependence, oral health status, DT index, MT index, FT index, denture status, FTUs and Dry mouth.

\* $P < 0.05$ .

swallowing difficulty<sup>25</sup> but also a key indicator of oral function.<sup>8,26</sup> According to the Japanese Society of Gerodontology, tongue pressure should surpass 20 kPa to be sufficient for oral function.<sup>10</sup> In 2021, Liu et al. conducted a

cross-sectional study in Taiwan and found that the mean tongue pressure among 1000 participants was 27.18 kPa,<sup>27</sup> indicating that the sample recruited for the present study did, indeed, exhibit lower-than-average tongue pressure.



This study found that participants' tongue pressures continued to improve over the course of the 3-month intervention period (Fig. 1). The mean tongue pressure value at the end of the study was  $20.63 \pm 10.45$  kPa, which was significantly higher than the baseline value ( $16.92 \pm 10.62$  kPa,  $p < 0.001$ ). Oral exercise, as developed by Kitahara and Hakuta in 2008, was originally designed to be a simple and effective self-management intervention for improving oral function in older adults. Oral exercise has also been used for rehabilitating patients with swallowing difficulties. The findings of this study are comparable with those of Kim et al., 's 2019 study, in which 84 healthy participants aged >65-years performed oral exercise twice a day for 1 week. In that study, 40% of the participants who had swallowing hypofunction (swallowing <3 times in a repetitive saliva swallowing test) exhibited significant improvement by the end the intervention period.<sup>28</sup> Another study found that oral exercise can improve an individual's tongue pressure from  $18.4 \pm 11.5$  kPa to  $23.5 \pm 12.5$  kPa ( $p < 0.0001$ ).<sup>29</sup> In summary, oral exercise can be applied in health promotion programs and even in rehabilitation to improve the tongue pressure and swallowing ability of older adults.

Age is a major predisposing factor for noncommunicable diseases, such as cancer and cardiovascular disease, and oral diseases are no exception. In this study, although tongue pressure generally decreased with age, all participants strengthened their tongue pressure through oral exercise over the course of the intervention period, with improvements ranging from 0.60 (among those aged 80–89) to 6.71 (among those aged 70–79) kPa. Even participants aged  $\geq 90$  years exhibited a 4.92 kPa improvement in tongue pressure (Table 1). These results were comparable with those of Miyoshi et al., 's 2019 study, which reported that age had a negative linear association with tongue pressure ( $r = -0.35$ ,  $p < 0.001$ ).<sup>30</sup> The decreased tongue pressure and oral function associated with aging can be attributed to a reduction in masseter muscle volume and in masseter muscle and labial mobility.<sup>31,32</sup> Nevertheless, oral exercise can have a positive effect on older adults regardless of age. Iwao-Kawamura et al. recruited 34 women aged  $\geq 70$  years for a 3-month oral exercise health program in 2021. They also found that both the younger group (aged 70–79) and the older group (aged 80–89) exhibited significant improvement in their repetitive saliva swallowing test.<sup>33</sup> This suggests that the benefits of oral exercise include not only strengthening skeletal muscles and improving tongue and lip movement but also improving saliva flow rates.<sup>15</sup> These results highlighted the importance of oral exercise in improving swallowing function and reducing the risk of swallowing difficulties in older adults.

In this study, is no significant difference in the changes in tongue pressure with dry mouth and denture wear but participants with one to seven pairs of FTUs exhibited significantly more improvement of tongue pressure than those without FTUs ( $p = 0.021$ , Table 3). This result was comparable with that of Hildebrandt et al., 's 1997 study and Tashiro et al., 's 2021 study: both found that patients with fewer FTUs tended to report more difficulty in chewing or lower tongue pressure.<sup>34,35</sup> Therefore, older adults should retain as many FTUs as possible to prevent the reduction of tongue pressure.

Regular oral exercise can improve oral and physical function that were the ability of self-care, no need assistance and walk by their self and inhibit deterioration of oral function in older adults.<sup>36,37</sup> Oral exercise can not only improve tongue pressure and prevent oral frailty but also promote physical activity through promoting social interaction, especially for community-dwelling older adults. Therefore, comprehensive integrated programs including physical exercise, oral health-related activities (i.e. oral exercise, tooth brushing instruction, and tongue pressure measurement), and nutritional guidance may contribute to the improvement and maintenance of oral and physical function in older adults in community day care centers.

This study had some limitations. First, the study did not include a control group that did not participate in the oral exercise intervention. Therefore, we could not determine whether the Hawthorne effect was present, and no causal inference can be made. Second, our results demonstrated that the tongue pressures of the participants continued improving during the 12-week oral exercise intervention period. If the study period had been extended, a more accurate result—or one indicating greater improvement among participants—might have been achieved because older adults ought to continue regular oral exercise for as long as possible to prevent age-related tongue weakness.<sup>38,39</sup> However, the community day care centers were closed due to the COVID-19 pandemic, and the follow-up period was limited.

This prospective cohort study recruited 66 older participants for a weekly oral exercise program and monitored the changes in their tongue pressure measurements. After the 3-month intervention period, the data indicated that oral exercise had a positive effect on the participants' tongue pressure regardless of their gender or age group. Tongue pressure measurement is a simple and convenient method for evaluating swallowing dysfunction and is therefore worth implementing in more community day care centers and facilities. Furthermore, oral exercise should be integrated into comprehensive health promotion programs to assist in the improvement and maintenance of oral function among older adults.

## Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

## Acknowledgments

This project was supported by National Yang Ming Chiao Tung University Far Eastern Memorial Hospital Joint Research Program (grant number: NYCU-FEMH 108-DN-08) and Taipei City Hospital (grant number: 107XDAA00149).

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