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Article

## The Effect of Oral Stimulation Exercises to Improving the Function of Swallowing, Mastication, and Salivary Flow Rate on the Elderly

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### Abstract

Oral health issues are prevalent among the elderly due to physiological aging, which often leads to decreased oral muscle function and impairs essential activities such as mastication, swallowing, and salivary secretion. This study aimed to evaluate the effectiveness of oral stimulation exercises in improving these oral functions in elderly individuals. A pre-experimental one-group pre-test and post-test design was conducted involving 28 elderly participants in Pedalangan Village, Semarang, Indonesia. Participants received regular oral stimulation exercises, and assessments were made before and after the intervention. Data were analyzed using the Shapiro-Wilk test for normality, with paired sample t-tests and Wilcoxon tests applied accordingly. The results demonstrated significant improvements in salivary flow rate ( $p = 0.018$ ), swallowing function ( $p = 0.000$ ), and mastication ability ( $p = 0.004$ ). These findings suggest that oral stimulation exercises are an effective non-pharmacological strategy to enhance oral functions among the elderly, potentially improving their overall health and quality of life.

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### Keywords:

1. Elderly
2. Oral stimulation
3. The Function of Swallowing
4. Saliva Flow

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## Introduction

The decline in oral structure and muscle function in older adults, including weakened tongue propulsion and prolonged reaction times, significantly impacts nutritional status, hydration, and overall health, increasing the risk of malnutrition, dehydration, dysphagia, and aspiration pneumonia[1]. Studi[2] found a significant relationship between oral function problems, such as difficulty chewing and swallowing, and malnutrition in older adults, highlighting the importance of addressing oral health to prevent malnutrition and related health problems in older adults[2]. As the global elderly population increases, the need for easily accessible non-pharmacological interventions becomes increasingly urgent. Recent meta-analyses and systematic reviews indicate that oropharyngeal exercises, particularly tongue strength exercises, swallowing exercises, and mouth-lip relaxation and stimulation, have significant positive effects on tongue pressure, oropharyngeal muscle strength, and saliva flow[3]–[5]. One RCT study in Thailand compared a simple oral exercise (SOE, 2 minutes per session) and traditional oral exercise (TOE, 15 minutes per session) programme over three months and found that both methods effectively increased tactile saliva flow, while TOE provided a

more significant improvement in swallowing function[6]. Meanwhile, a study in South Korea in 2023 reported that a four-month oral function training programme resulted in significant improvements in bite force, tongue pressure, and simulated swallowing flow rate (Simulated SFR) in community-dwelling older adults without dysphagia[7]. Innovative technology-based programmes are also beginning to emerge, such as an ICT-based oral Pilates application developed in 2024, with a design based on systematic findings and a Delphi panel of experts; this content is packaged in an interactive game to improve oral exercise compliance in older adults[8].

Although evidence supports the benefits of various oral interventions, there are several challenges. First, study approaches vary widely: from healthy elderly populations, elderly individuals with mild dementia, to stroke patients with dysphagia, limiting the generalisability of findings to the general elderly population in the community. Second, the duration, intensity, and format of exercises (2 minutes vs. 15–60 minutes, oral-only vs. combined tongue strength) differ significantly, making it difficult to compare results and establish optimal protocols. Third, most studies assess outcomes only in the short term (1–4 months), so it is unclear whether improvements in oral function can be maintained in the long term (>6 months). Finally, many interventions rely on specialised equipment (e.g., Peco-Panda®) or professional supervision, which may not be practical for independent older adults in the community. This creates a real need for studies focusing on simple, self-administered oral stimulation exercises that can be practised at home and comprehensively evaluated in the short and long term using objective outcomes such as saliva flow rate, tongue pressure, bite force, RSST, and nutritional parameters.

Thus, although initial evidence of the success of oropharyngeal interventions is promising, there are still significant gaps in terms of standard exercise protocols, optimal duration and intensity, sustainability of results, and accessibility at the community level. This study aims to address these gaps by designing and testing an oral stimulation exercise programme that is easy for older adults in the community to perform without special equipment or intensive supervision—and conducting a multidimensional and multi-tempo pre–post test evaluation (pre-intervention, post-3 months, 6-month follow-up). With this approach, it is anticipated that a practical, effective, and sustainable oral intervention protocol will be developed to improve oral function, nutritional status, hydration, and quality of life among the elderly, while also serving as a evidence-based population intervention model for many communities.

## **Materials and Methods**

### **Research Design**

This study used a pre-experimental design with a one-group pretest-posttest approach. This design involved one group of subjects who were given treatment or intervention, where measurements were taken before and after treatment to assess changes or effects of the intervention. This design was chosen because the primary objective of the study is to evaluate the effectiveness of oral stimulation exercises on improving swallowing function, chewing ability, and saliva flow rate in the elderly.

### **Population and Sample**

The population in this study was all elderly people living in the Pedalangan sub-district, Banyumanik district, Semarang city, Central Java. The inclusion criteria established in this study included elderly people aged over 60 years, able to communicate well, without neurological disorders or anatomical abnormalities in the mouth, and willing to become respondents by signing an informed consent form. Exclusion criteria include elderly individuals with facial paralysis, severe motor impairments, or other medical conditions that may hinder the implementation of oral stimulation exercises. The study sample consisted of 28 participants, selected through purposive sampling based on the established inclusion criteria. This sample size was deemed adequate for a pre-post test design, considering statistical considerations and experience from similar studies.

## Research Location and Time

This study was conducted in Pedalangan Village, Banyumanik District, Semarang City. The location was selected based on the consideration that the area has a sufficient elderly population and has established cooperation with the research team in previous community health activities. The research was conducted from the preparation phase in February 2024 until the completion of data collection in April 2024, encompassing activities such as socialisation, intervention implementation, and pre-test and post-test measurements.

## Prosedur Intervensi

The primary intervention in this study was oral stimulation exercises designed to improve swallowing, chewing, and saliva flow. The intervention was administered in the form of a series of stimulating movements of the facial muscles, lips, cheeks, tongue, and salivary glands. The exercises were conducted for 21 consecutive days, with a frequency of once daily in the morning. The exercises included cheek muscle stretching, tongue movements in various directions, breathing through the nose and mouth, and stimulation of the parotid and submandibular areas through light massage. Each exercise session lasts approximately 10–15 minutes and is performed independently by participants after receiving training from the researcher. The researcher provides a direct demonstration at the beginning of the intervention and provides visual guidelines (leaflets) that participants use as a reference during independent implementation at home.

During the intervention period, researchers conducted regular monitoring to ensure that the exercises were performed correctly and consistently. Elderly people who needed assistance received guidance from local health workers who had been trained beforehand. Data collection was conducted twice, before the intervention (pretest) and 21 days after the intervention (posttest), to measure changes in the variables under study.

## Measurement Instruments and Techniques

Measurements were taken for three main variables, namely saliva flow rate, swallowing function, and mastication function. Saliva flow rate was measured using the *spitting method* without stimulation (*unstimulated whole saliva*), in which respondents were asked to collect saliva in their mouths for five minutes and spit it into a calibrated measuring tube. The volume of saliva was then calculated in mL/minute. This measurement is performed in the morning before eating or drinking to obtain valid and consistent results.

Swallowing function is measured using a standardised questionnaire instrument that assesses the speed and ability to swallow water in a certain volume, as well as symptoms of dysphagia such as choking or food residue in the oral cavity. The assessment is based on observation scores by researchers using clinical parameters from the Rapid Swallowing Screening Test (RSST) that has been adjusted.

Chewing function is evaluated through observation of the ability to chew certain soft foods and the time required to form a bolus before swallowing. Assessment is carried out using a Likert scale based on parameters of mastication efficiency, such as chewing time, chewing frequency, and jaw movement coordination.

## Analisis Data

The data obtained were analysed using SPSS software version 22.00. Before conducting the hypothesis test, the data were first tested for normality using the Shapiro-Wilk test, because the sample size was less than 50 people. For normally distributed data, the paired sample t-test was used to determine the difference in values before and after the intervention. For non-normally distributed data, the Wilcoxon Signed-Rank Test was used.

All tests were conducted at a significance level of 5% ( $\alpha = 0.05$ ). The results of the statistical analysis are presented in the form of distribution tables, mean values, standard deviations, and p-values used to interpret the significance of changes in the three main variables of the study.

Results

This study aims to determine the effect of oral stimulation exercises on three main functions of the oral cavity in the elderly, namely saliva flow rate, swallowing function, and mastication function. A total of 28 elderly respondents participated fully in the study and completed measurements both before and after the intervention. Before conducting the effectiveness test, a normality test was first performed using the Shapiro-Wilk test to determine whether the data were normally distributed or not. The results showed that most of the data, including saliva flow (pretest and posttest), mastication (pretest and posttest), and posttest swallowing, were not normally distributed ( $p < 0.05$ ). Only the pretest swallowing variable showed a normal distribution ( $p > 0.05$ ). Based on these results, the Wilcoxon Signed-Rank test was used for non-normal data and the paired sample t-test for normal data.

Table 1. Data Normality Test Results (Shapiro-Wilk Test)

Variable	Data Types	p-value	Data distribution
Saliva Flow	Pretest	0.022	Not Normal
	post-test	0.003	Not Normal
Swallowing	Pretest	0.248	Normal
	post-test	0.039	Not Normal
Mastication	Pretest	0.020	Not Normal
	post-test	0.002	Not Normal

The results of the analysis indicate that there are statistically significant differences between the pretest and posttest values for all three variables measured. For the saliva flow variable, there was an increase in the mean value from  $0.33 \pm 0.23$  mL/minute to  $0.42 \pm 0.25$  mL/minute after the intervention. The Wilcoxon test yielded a p-value of 0.018, indicating that oral stimulation exercises are effective in increasing saliva secretion in the elderly. In the swallowing function, the average score increased from  $3.75 \pm 1.60$  to  $3.96 \pm 1.40$  after the intervention. Based on the results of the paired sample t-test,  $p = 0.000$  was obtained, which means that there was a significant improvement in swallowing function due to regular exercise. Meanwhile, the mastication score also showed a significant increase from the initial value of  $10.04 \pm 2.89$  to  $11.36 \pm 3.48$  after 21 days of training. The Wilcoxon test showed a p-value of 0.004, confirming that oral muscle stimulation training can improve chewing ability in the elderly.

Table 2. Results of the Effectiveness Test of Oral Stimulation Exercises on Oral Function in the Elderly

Variable	Pretest (Mean $\pm$ SD)	Post-test (Mean $\pm$ SD)	p-value	Statistical test
Saliva Flow (mL/min)	$0.33 \pm 0.23$	$0.42 \pm 0.25$	0.018	Wilcoxon
Swallowing	$3.75 \pm 1.60$	$3.96 \pm 1.40$	0.000	Paired t-test
Mastication	$10.04 \pm 2.89$	$11.36 \pm 3.48$	0.004	Wilcoxon

Overall, these findings indicate that oral stimulation exercises performed regularly for 21 days have a significant positive effect on oral physiological function in older adults. These exercises mechanically stimulate the facial muscles, tongue, and salivary glands, directly impacting increased saliva production, oral muscle strength, and functional movement coordination such as swallowing and chewing. These results reinforce the evidence that simple, non-pharmacological, and low-cost interventions such as oral stimulation exercises can be an effective strategy for maintaining and improving the quality of life of the elderly through improved oral function..

Discussion

The results of this study indicate that oral stimulation exercises significantly improve swallowing function, chewing ability, and saliva flow rate in older adults. All three variables measured

showed statistically significant improvements after 21 days of intervention, indicating that simple exercises that stimulate the muscles of the mouth and face can have a real physiological impact on the elderly population. Oral exercises have been proven to improve swallowing ability, with studies showing that 25% to 40% of participants improved from poor swallowing status to good after intervention[9]. Repeated Saliva Swallowing Test (RSST) showed a significant improvement in swallowing function, especially in traditional oral exercise programmes.[6]. Simple oral exercises led to a 16% improvement in chewing performance, particularly beneficial for those who initially had poor chewing ability[9].

An increase in saliva flow rate after intervention was one of the important findings, considering that decreased saliva secretion is a common condition experienced by the elderly, known as *xerostomia*. This condition is often caused by age, the effects of medication, and degeneration of the salivary glands. Stimulation exercises involving mechanical movements of the cheeks and tongue, as well as light massage of the parotid and submandibular glands, have been shown to stimulate the saliva secretion reflex through activation of the parasympathetic nerves. This mechanism is mediated by stimulation of orofacial mechanoreceptors that send impulses to the salivatory nucleus in the brainstem, triggering the release of acetylcholine, which plays a role in increasing blood flow and saliva production[10], [11]. These findings are consistent with the results of the study[9] which indicates that regular stimulation of the tongue and cheek muscles increases the amount of saliva produced without external stimulation (*unstimulated saliva*), with improvements achieved even after two weeks of intervention. Increased saliva flow is crucial for maintaining oral health and preventing conditions associated with dry mouth, which are common in the elderly[12].

Improvements in swallowing function are also important evidence of the effectiveness of intervention. Dysphagia is one of the most common disorders in the elderly, resulting from a decline in the strength of the oropharyngeal muscles and neuromuscular coordination. Oral exercises such as those used in this study have a positive effect because they improve motor control of the tongue and pharyngeal muscles and strengthen the swallowing reflex. Repeated exercises can facilitate the activation of reflex pathways involving the brainstem, particularly the swallowing centre in the medulla oblongata. Previous studies in Taiwan support this, where tongue pressure exercises over three weeks increased tongue strength and reduced the risk of choking in elderly individuals at a day care centre[13].

Significant results in mastication function are also consistent with previous studies. Mastication ability is highly dependent on the number and position of teeth, the integrity of the masseter and temporalis muscles, and coordination between the tongue and lower jaw. The common loss of posterior teeth in the elderly leads to a decrease in mastication efficiency, which often results in changes in eating patterns and poor nutritional status. Oral stimulation exercises in this study also involved movements that train the muscles of the cheeks, jaw, and tongue, thereby improving masticatory muscle tone and sensorimotor control. The increased mastication scores in this study confirm that even simple exercises can improve chewing performance in elderly individuals, as also demonstrated by[14] who found that elderly people with oral hypofunction who were given orofacial muscle exercises showed more efficient chewing times and better bolus formation.

Physiologically, oral stimulation exercises work through two main mechanisms. First, the exercises mechanically activate baroreceptors and chemoreceptors in the oral cavity, which stimulate the salivary and swallowing centres in the brain. Second, facial and tongue muscle movements increase tissue perfusion, improve muscle elasticity, and enhance afferent signals to the central nervous system, ultimately enhancing functional motor coordination of the mouth.[15] In addition, increased muscle use can also slow down muscle atrophy due to ageing, or even restore some of the muscle strength that has been lost.



The main strength of this study lies in the simplicity and affordability of the intervention. Oral stimulation exercises do not require any equipment, are non-invasive, can be performed independently by older adults, and show significant results in a relatively short period of time. This makes them highly promising for implementation in community health programmes or health worker-led interventions. Additionally, the combination of educational and practical approaches gives this intervention high translational value in the context of primary healthcare, particularly in resource-limited settings such as developing countries.

However, this study has several limitations that need to be considered. First, the pre-experimental design without a control group limits the inferential ability regarding the causal effects of the intervention. Second, the sample size is relatively small and limited to one region, so generalisation of the results to a wider population needs to be done with caution. Third, the evaluation was conducted over a short period (21 days), while the long-term effects of oral exercises on physiological functions require further investigation. Measurements using subjective instruments such as Likert scales may introduce perceptual bias, although the measurements were supplemented with objective clinical parameters such as saliva volume.

For further research, it is recommended to use a randomised controlled trial (RCT) design with a longer intervention duration and involving a more heterogeneous population. The inclusion of additional clinical parameters such as tongue pressure, bite force, or nutritional status could further enrich our understanding of the physiological effects of this exercise. The integration of digital technology, such as exercise guidance apps or self-monitoring tools, is also worth exploring to enhance compliance and sustainability of the intervention.

## **Conclusions**

Oral stimulation exercises have been proven effective in improving oral physiological function in the elderly, particularly in terms of increasing saliva flow rate, swallowing ability, and chewing function. This simple intervention mechanically stimulates facial and tongue muscles as well as salivary glands, directly contributing to improved neuromuscular coordination and oral secretion. These findings support the use of oral stimulation exercises as an affordable and easily implementable non-pharmacological approach in promotive and preventive oral health efforts for the elderly population.

These findings provide a scientific basis for integrating oral stimulation exercises into community health programmes, especially for independent elderly people. To strengthen the evidence, further research with a controlled randomised design, longer intervention duration, and a larger sample size is highly recommended. This intervention has great potential for widespread application in improving quality of life and maintaining functional independence in old age.

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Not Applicable.

## **Informed Consent Statement**

Informed consent was obtained from all subject involved in the study.

## **Conflicts of Interest**

The authors declare no conflict of interest.

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