



## ARTICLE

### EFFECTIVENESS OF EXPIRATORY MUSCLE STRENGTH TRAINING ON DYSPHAGIA RISK IN PRE-FRAIL ELDERLY

Ida Ayu Putu Diana Janaki Sari<sup>1</sup>, Erna Setiawati<sup>1\*</sup>, Lisa Nurhasanah<sup>1</sup>

<sup>1</sup> Fakultas Kedokteran, Universitas Diponegoro, Semarang, Jawa Tengah, Indonesia

\*Correspondence email : [roswithaerna@fk.undip.ac.id](mailto:roswithaerna@fk.undip.ac.id)

#### ABSTRACT

Pre-frailty is a state between frailty and robustness. Frail and pre-frail elderly are both susceptible to dysphagia. Pre-frail elderly may respond better to intervention rather than frail people. Therefore, detection and intervention for dysphagia should be done early in pre-frail elderly. Expiratory muscle strength training (EMST) is a recent intervention for dysphagia. However, effectiveness of EMST on pre-frail elderly are still unclear. This study aimed to investigate effectiveness of expiratory muscle training on dysphagia risk of pre-frail elderly. The design of this study was a randomized clinical trial. Twenty-four pre-frail elderly randomly assigned into experimental group (n=12) or control group (n=12). The experimental group received expiratory muscle training using PEP Threshold® device 5 times per week for 6 weeks. Both of group also received typical multicomponent exercise for elderly 3 times per week for 6 weeks. Outcome measure was risk of dysphagia assessed using Swallowing Disturbance Questionnaire (SDQ). The intra-group analysis showed significant differences pre- and post-intervention in experimental group (p<0,001). Inter-group analysis showed significant differences between experimental and control group post-intervention (p<0,001). This finding indicates that expiratory muscle training effective on reducing dysphagia risk in pre-frail elderly.

**Keywords:** Dysphagia; Elderly; Expiratory Muscle Training; Pre-frailty.

#### АБСТРАКТ

Предхрупкость - это состояние между хрупкостью и прочностью. Хрупкие и прехрупкие пожилые люди подвержены дисфагии. Предобморочные пожилые люди могут лучше реагировать на вмешательство, чем хрупкие. Таким образом, выявление дисфагии и вмешательство в нее должны проводиться на ранних стадиях у пожилых людей, находящихся в преклонном возрасте пожилых людей. Тренировка силы экспираторной мускулатуры (EMST) является одним из недавних методов лечения дисфагии. для лечения дисфагии. Однако эффективность EMST у пожилых людей до сих пор неясна. Целью данного исследования было изучить эффективность тренировки экспираторных мышц на риск развития дисфагии риска дисфагии у пожилых людей предпенсионного возраста. Дизайн исследования представлял собой рандомизированное клиническое исследование. исследование. Двадцать четыре пожилых человека престарелого возраста были рандомизированы распределены на экспериментальную (n=12) и контрольную (n=12) группы. В экспериментальной группе проводилась тренировка экспираторной мускулатуры с использованием прибора PEP Threshold® 5 раз в неделю в течение 6 недель. Обе группы также получали обычные многокомпонентные упражнения для пожилых людей 3 раза в неделю в течение 6 недель. Исходным показателем был риск развития дисфагии, который оценивался с помощью опросника Swallowing Disturbance Questionnaire (SDQ). Внутригрупповой анализ показал значимые различия до и после вмешательства в экспериментальной группе (p<0,001). Межгрупповой анализ показал значительные различия между экспериментальной и контрольной группами после вмешательства (p<0,001). Полученные результаты свидетельствуют о том, что тренировка экспираторной мускулатуры тренировки экспираторных мышц эффективно снижает риск развития дисфагии у пожилых людей предпенсионного возраста.

**Ключевые слова:** Дисфагия; пожилые люди; Тренировка экспираторной мускулатуры; предобморочное состояние.

## INTRODUCTION

Dysphagia is a condition characterised by challenges or discomfort in the movement of food from the mouth cavity to the stomach. It is a prevalent health issue that commonly affects the senior population. Dysphagia exhibits a high prevalence among the older population. According to the findings of Wang et al., a range of 10% to 27% of older individuals residing in community settings and 40% to 60% of senior individuals residing in nursing facilities exhibit symptoms. The user's text is too short to be rewritten academically. Dysphagia gives rise to several ramifications in the elderly population, encompassing malnutrition, dehydration, and aspiration pneumonia, so exerting adverse impacts on their physical well-being and overall quality of life. Frailty is clinical syndrome a high vulnerability state due to progressive decline in physical, mental, and social functions.<sup>3</sup> Frail older people often have sarcopenia, age-related loss of muscle mass and strength. Sarcopenia may affect the muscles involved in swallowing.<sup>2</sup> The frailty process follows a continuous pattern. Fried et al. proposed frailty phenotype and defined a pre-frail criterion between frailty and robustness state.<sup>4,5</sup> There was association between degree of frailty with the risk of developing dysphagia.<sup>6</sup> Dysphagia risk increased more in frail (48.9%) and pre-frail (32.4%) individuals than those who were robust (13.6%).<sup>2</sup> Recent evidence showed that pre-frail elderly may respond better to intervention rather than already-frail people.<sup>7</sup> Therefore, detection and intervention of swallowing dysfunction in pre-frail elderly people need to be done early.

Expiratory muscle strength training (EMST) is a recent intervention for training swallowing muscles. Park et al. reported that EMST activated the suprahyoid muscles and strengthened the orofacial muscles in the healthy older people effectively.<sup>8</sup> Eom et al. suggested that EMST was effective in treating dysphagia in post-stroke elderly patients.<sup>9</sup> Claus et al. reported EMST significantly reduces overall dysphagia severity in Parkinson Disease patients.<sup>10</sup> However, studies on the effect of EMST on pre-frail elderly with dysphagia are lacking. Therefore, we investigated the effectiveness of 6-week EMST application on risk of dysphagia in pre-frail elderly.

## MATERIAL AND METHODS

The study was conducted between February until March 2023 and had a randomized clinical trial design. All participants signed an informed

consent form prior to intervention. The study was reviewed and approved by the local Ethics Committee RSUP DR Kariadi Semarang (No.1362/EC/KEPK-RSDK/2022).

Twenty-four pre-frail elderly at Rindang Asih I, Semarang and Rindang Asih II, Ungaran elderly nursing homes participated in this study. Inclusion criteria were: (1) age 60-80 years old, (2) pre-frail elderly with Fried Frailty Index score 1 or 2, (3) no cognitive impairment (MOCA-Ina  $\geq$  26). Exclusion criteria were: (1) uncontrolled hypertension (blood pressure  $\geq$ 180/110 mmHg), (2) severe cardiorespiratory condition (severe dyspnoea, recent myocardial infarction, severe valvular disease) (3) musculoskeletal disorder that interferes with exercise, (4) neurodegenerative disease, deformities of head, mouth, oropharyngeal and oesophageal that interfere with swallowing function. Then they were randomly assigned using simple group allocation into the experimental group or the control group. All participants received *senam lansia* as a typical multicomponent exercise for elderly, 3 times per week for 6 weeks. In addition to *senam lansia*, the experimental group received EMST program 5 times per week for 6 weeks. For EMST program, participants performed expiratory muscle strength training using a hand-held device (Threshold® PEP Respironics; Philips Co.), 3 sets of 10 breaths, 1 minute rest between sets, with initial intensity 60% of the individual's maximal expiratory mouth pressure (MEP).<sup>11</sup>

The study outcome was assessed at the beginning and at the end of the 6-week intervention. Outcome measure was dysphagia risk assessed by Swallowing Disturbance Questionnaire (SDQ). SDQ is a validated dysphagia screening tool consisting 15 questions. Questions 1-5 are contributed to the oral phase of swallowing, and questions 6-15 are contributed to the pharyngeal phase.

Questions 1 to 14 were rated by 0-3 scale (0 for never had symptoms and 3 for very frequent symptoms) and the last question was a "yes/no" question (yes was scored 2.5, and no was scored 0.5). Maximum score was 44.5. SDQ score  $\geq$  12.5 indicates possible swallowing problems.<sup>12,13</sup> SPSS® version 26 software was used to perform statistical analysis. The Shapiro-Wilk test was used to confirm data normality assumptions. Both the intra- and inter-groups comparisons of SDQ scores were performed using independent samples t test. P-value of  $<0.05$  will be considered as statistically significant.

## RESULT

A total 24 participants consisted of 14 males and 10 females included in this study. The mean age of the participants were  $69,50 \pm 5,11$  years. Among those participants, 50% had 2 frailty criteria and 50% had 1 frailty criterion. All participants had low physical activities. Each group consisted of 12 participants. No significant differences were found in demographic characteristics of the study groups ( $P > 0.05$ ; Table 1). Due to the location and nature of the intervention, no blinding is conducted. Until the end of this study, all of 24 subjects' data were analysed. There were no drop out subjects in this study.

There were no statistically significant variations observed in the SDQ scores between the groups prior to the implementation of the intervention. The experimental group had a substantial improvement in SDQ scores after receiving the intervention, with scores decreasing from  $15.25 \pm 1.42$  to  $8.58 \pm 1.73$  ( $p < 0.001$ ). In contrast, the control group did not show a significant change in SDQ scores ( $p = 0.107$ ). Following the implementation of the intervention, a rigorous statistical analysis revealed a notable and statistically significant distinction between the groups ( $p < 0.001$ ). The outcome can be shown in Table 2.

## DISCUSSION

Frail and pre-frail elderly are at an increased risk of developing dysphagia than non-frail elderly. Bahat et al. showed that dysphagia was independently associated with frailty.<sup>1</sup> Gonzalez et al. observed that pre-frail elderly already had higher risk of dysphagia than robust people.<sup>14</sup> Dysphagia may leads to severe consequences, such as malnutrition, aspiration pneumonia, psychological problems and even death.

EMST is one of the emerging approach for exercising swallowing-related muscles. This study used Threshold® PEP Respiration hand held device to train swallowing muscles. This device overload the muscles using a one-way valve loaded with spring. A person needs to produce and maintain sufficient expiratory pressure to open the valve. The pressure can be adjusted to increase the resistance progressively.<sup>15,16</sup> This device is portable and easy to use.<sup>8</sup>

Our findings indicate that including expiratory muscle training in a typical rehabilitation program reduced dysphagia risk in pre-frail elderly. The experimental group showed statistically significant difference in the change of SDQ score before and after intervention ( $p < 0.05$ ). No significant differences were observed between the groups ( $p < 0.05$ )

**Table 1.** Baseline characteristics for the experimental and control groups

Variable	Groups		p
	Experimental	Control	
Age	$68,67 \pm 6,37$	$70,33 \pm 3,55$	0,437
Gender			
Male	6 (42,9%)	8 (57,1%)	0,679
Female	6 (60,0%)	4 (40,0%)	
Body weight	$53,42 \pm 10,26$	$53,75 \pm 14,18$	0,817
Body height	$154,33 \pm 8,13$	$153,17 \pm 9,18$	0,745
BMI	$22,44 \pm 4,09$	$22,64 \pm 4,17$	0,840
Frailty criteria			
1	6 (50%)	6 (50%)	1,000
2	6 (50%)	6 (50%)	
Physical Activities			
Low	12 (50%)	12 (50%)	-
Normal	0 ( 0%)	0 ( 0%)	
SDQ pretest	$15,25 \pm 1,42$	$16,08 \pm 3,32$	0,436

**Table 2.** Changes in SDQ scores before and after intervention

SDQ	Groups		p
	Experimental	Control	
Pre test	15,25 ± 1,42	16,08 ± 3,32	0,436
Post test	8,58 ± 1,73	15,25 ± 3,60	<0,001*
p	<0,001*	0,107	
Difference	-6,67 ± 1,50	-0,83 ± 1,40	<0,001*

Note: \* Significant ( $p < 0,05$ )

Furthermore, the inter-group comparison showed a statistically significant difference in SDQ score ( $p < 0.05$ ) after completion of 6 weeks intervention. This finding is similar with several previous studies that confirmed beneficial role of EMST in swallowing function of elderly populations.<sup>8-11</sup>

Several studies employing electromyography and pharyngeal manometry showed beneficial effects of EMST on orofacial, suprahyoid muscle, and velopharyngeal closing pressure.<sup>8,9</sup> Hence, it is assumed that improvement of swallowing function by EMST resulted from orofacial and pharyngeal muscle activation. Frail and pre-frail elderly often have reduced skeletal muscle mass and motor unit numbers, including swallowing-related muscle that increases vulnerability to dysphagia.<sup>2</sup> Therefore, we posit that EMST has the potential to reduce the likelihood of dysphagia in pre-frail elderly individuals by engaging in exercises that target the orofacial and suprahyoid muscles.

Approximately 60–70% of 1-repetition maximum (1 RM) of resistance exercise is required for improving skeletal muscle strength. And at least 4 weeks training duration is required for increased skeletal muscle strength and mass.<sup>8-10</sup> We also applied these values to our study protocol, considering appropriate values for activation of the swallowing muscles.

There are certain constraints in this study. Initially, there was a lack of subsequent evaluation. The result was assessed immediately following the conclusion of the intervention. The long-term sustainability of the intervention's advantages remains uncertain. Second, the sample size was

relatively small, which implies that caution should be made when interpreting the results. Lastly, due to the location and nature of the intervention, we cannot blind the group allocation. Thus, the placebo effect and observer bias cannot be excluded. Further blinded studies with larger sample size and long-term follow-up assessments are required to address these limitations.

## CONCLUSION

The results of this study confirmed the effectiveness of EMST in lowering dysphagia risk of pre-frail elderly. We recommend incorporating EMST in typical rehabilitation of pre-frail elderly as a preventive measure for dysphagia.

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## DECLARATIONS

The authors declared no conflicts of interest.

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