

# Electromyographic measures of suprahyoid musculature during the swallowing of older adults

Medidas eletromiográficas dos músculos supra-hióideos durante a deglutição de idosos

Mediciones electromiográficas de los músculos suprahióideos durante la deglución de los ancianos

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## Abstract

**Introduction:** Muscle flaccidity and mass loss are expected anatomico-physiological changes resulting from the aging process. They can cause alterations in the myoelectrical behavior of muscles involved in swallowing. **Purpose:** To characterize the electromyographic measures of the suprahyoid musculature during the swallowing of older adults. **Method:** A total of 49 older adults of both genders on exclusive oral feeding participated in this study. The assessment instruments used were data record sheet and surface electromyography (SEMG) of the suprahyoid musculature (SHM) when swallowing 10 ml and 20 ml of water and 5 ml and 10 ml of creamy yogurt, as well as continuous ingestion of 100 ml of water. **Results:** The amplitude was higher in greater volumes, both of water and yogurt ( $p = 0.0000$  and  $p = 0.0048$ , respectively). The amplitude for yogurt was higher than that for water ( $p = 0.0000$ ), regardless of the age

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### Authors' contributions:

BLR - performed the collection and writing of the article.

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CD, SDM, FPR - collaborated in the analysis of the software.

MGWSC - contributed with the collection and final review of the article.

OGL - performed the statistical analysis and review of the article.

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group analyzed. The electromyographic duration was longer for yogurt than for water (main effect for consistency,  $p = 0.0001$ ). The swallowing of those 80 years old or more took significantly longer in both volumes of water and yogurt when compared with the other age groups: 60-69 ( $p = 0.0027$ ), 70-79 ( $p = 0.0012$ ). **Conclusion:** The creamy consistency of food proved to influence the duration and amplitude of this activity, regardless of the age group studied. In the sample studied, the electromyographic duration of the suprahyoid musculature proved to be the electrophysiologic parameter most influenced by the aging process, as it lasted longer in adults 80 years old or more.

**Keywords:** Deglutition; Aging; Electromyography.

## Resumo

**Introdução:** A perda de massa e flacidez muscular são mudanças anatomofisiológicas esperadas como processo de envelhecimento, podendo causar mudanças no comportamento mioelétrico de músculos envolvidos na deglutição. **Objetivo:** Caracterizar as medidas eletromiográficas dos músculos supra-hióideos durante a deglutição de idosos. **Método:** Participaram 49 idosos de ambos os sexos que se alimentavam por via oral exclusiva. Os instrumentos de avaliação utilizados foram: ficha de registro de dados e a eletromiografia de superfície (EMGs) dos músculos supra-hióideos (MSH) na deglutição de 10 ml e 20 ml de água e na deglutição de 5 ml e 10 ml de iogurte pastoso, assim como no consumo contínuo de 100 ml de água. **Resultados:** A amplitude foi mais elevada nos volumes maiores, tanto para a água como para o iogurte ( $p = 0,0000$  e  $p = 0,0048$ , respectivamente). A amplitude para o iogurte foi mais elevada que a amplitude para a água ( $p = 0,0000$ ) independentemente da faixa etária analisada. A duração eletromiográfica foi mais prolongada para iogurte que para água (efeito principal para consistência,  $p = 0,0001$ ). A deglutição dos idosos com idade  $\geq 80$  anos foi mais prolongada de forma significativa em ambos os volumes de água e iogurte quando comparados com demais grupos de faixas etárias: 60-69 ( $p = 0,0027$ ), 70-79 ( $p = 0,0012$ ). **Conclusão:** A consistência alimentar pastosa demonstrou influenciar a duração e a amplitude dessa atividade, independentemente da faixa etária estudada. Na amostra estudada, a duração eletromiográfica dos músculos supra-hióideos demonstrou ser o parâmetro eletrofisiológico mais influenciado pelo processo de envelhecimento, sendo mais prolongada em idosos com idade superior ou igual a 80 anos.

**Palavras-chave:** Deglutição; Envelhecimento; Eletromiografia.

## Resumen

**Introducción:** La pérdida de masa muscular y flacidez son cambios anatomofisiológicos esperados como proceso de envejecimiento y pueden causar cambios en el comportamiento mioelétrico de los músculos involucrados en la deglución. **Objetivo:** Caracterizar las mediciones electromiográficas de los músculos suprahioides durante la deglución de los ancianos. **Método:** 49 ancianos de ambos sexos que se alimentaban exclusivamente por vía oral participaron. Los instrumentos de evaluación utilizados fueron: forma de registro de datos y electromiografía superficial (EGI) de los músculos suprahioides (MSH) en la ingestión de 10 ml y 20 ml de agua y la deglución de 5 ml y 10 ml de yogur pastoso, así como el consumo continuo de 100 ml de agua. **Resultados:** La amplitud fue mayor en los volúmenes más grandes, tanto para el agua como para el yogur ( $p=0.0000$  y  $p=0.0048$ , respectivamente). La amplitud del yogur fue mayor que la del agua ( $p=0.0000$ ) independientemente del grupo de edad analizado. La duración electromiográfica fue más larga para el yogur que el agua. (ANOVA, efecto principal para la consistencia,  $p=0.0001$ ). La ingestión de los ancianos de 80 años fue significativamente más larga en volúmenes de agua y yogur en comparación con otros grupos de edad: 60-69 (Newman-Keuls  $p=0.0027$ ), 70-79 (Newman-Keuls  $p=0.0012$ ). **Conclusión:** La consistencia de los alimentos pastosos influyó en la duración y amplitud de la actividad de la MSH independientemente del grupo de edad. La duración electromiográfica de los músculos suprahioides demostró ser el parámetro electrofisiológico más influenciado por el proceso de envejecimiento, siendo más largo en ancianos de 80 años o más.

**Palabras clave:** Deglución; Envejecimiento; Electromiografía.

## Introduction

Swallowing is a complex neuromuscular function involving three phases: the oral, pharyngeal, and esophageal ones. The food is first chewed, crushed, and sent to the oropharynx with the tongue driving force, which characterizes the oral phase of swallowing. Then, the pharyngeal reaction is triggered, and the swallowing itself takes place<sup>1</sup>. In this phase, the food is driven toward the esophagus by the pharyngeal constrictors; the hyolaryngeal complex closes and moves forward and upward, while the vocal folds close; lastly, the cricopharyngeal muscle relaxes, and the upper esophageal sphincter opens – which starts the esophageal phase of swallowing<sup>2</sup>. In the aging process, this mechanism undergoes modifications and compensations<sup>1,2</sup>.

Aging is a process that brings about important changes in the aerodigestive structures, which have an impact on swallowing. In the oral cavity, it is common to lose teeth and have alterations in salivary flow, making the saliva thicker. This harms the preparation of the food bolus in the chewing process and swallowing. The decreased sensory capacity to perceive the texture, viscosity, temperature, taste, and smell of food when swallowing, along with changes in the tongue pressure activity, can potentialize the presence of residues in the oral cavity and oropharynx<sup>3</sup>.

The muscle mass loss, reduced muscle fiber diameter, and specific muscle fiber loss, which are characteristic of sarcopenia and cause muscular atrophy, have been described in the tongue, pharynx, and larynx. It is a condition that can impair the protection of the lower respiratory tract<sup>4</sup>. It is believed that the electrical activity of the muscles involved in the swallowing mechanism can be affected. The surface electromyography (SEMG) has been a widely used examination to obtain such measures<sup>4</sup>.

The SEMG is an examination that measures the electrical activity produced when the action potential of the motor units in the muscle fibers is triggered – which can be studied during the oropharyngeal phase of swallowing<sup>5,6</sup>. Considering the loss of muscle mass and fibers in structures important to swallowing due to aging, this study aimed to characterize the electromyographic measures of the suprahyoid musculature in the swallowing of older adults, taking consistency and age group into account.

## Method

This is an observational, descriptive, cross-sectional study conducted in compliance with the principles of the Declaration of Helsinki. It is part of a larger study, named “Standardization of surface electromyography of suprahyoid musculature in swallowing”, approved by the Human Research Ethics Committee of the Health Sciences Center at the *Universidade Federal de Pernambuco* (Federal University of Pernambuco) (evaluation report no. 375/08).

The research involving a convenience sample was conducted at the Electromyography Laboratory of the Clinics Hospital of the *Universidade Federal de Pernambuco* (HC/UFPE) and the research participants’ home in the microregion of Recife, Pernambuco, Brazil.

### Participants

The participants’ eligibility was verified based on a personal data collection sheet, developed for the study by the research group. Those included were adults at the age of 60 years or more, of both genders, with exclusive oral feeding. People with decompensated systemic diseases (such as diabetes and hypertension), neurological diseases, craniofacial abnormalities, lesions in phono-articulatory organs, the total absence of teeth, ill-fitted complete dentures, face and neck skin lesions were excluded from the research, as well as those who have undergone speech-language-hearing therapy, or who had difficulty understanding the instructions for the examinations.

All the participants signed the informed consent form (Appendix 1).

### Electromyographic records

The environments were prepared and tested before the assessments, taking the necessary precautions to avoid noise and/or interference to be picked up along with the SEMG signals. The support furniture to carry out the examination were made of either plastic or wood, the notebook was not plugged to an electrical outlet, and there was no external noise.

The SEMG was conducted in a four-channel electromyograph, model EMG400C, manufactured by *EMG System do Brasil Ltda.*, connected to a notebook. The software used to record the data was provided by *EMG System do Brasil*, whereas the

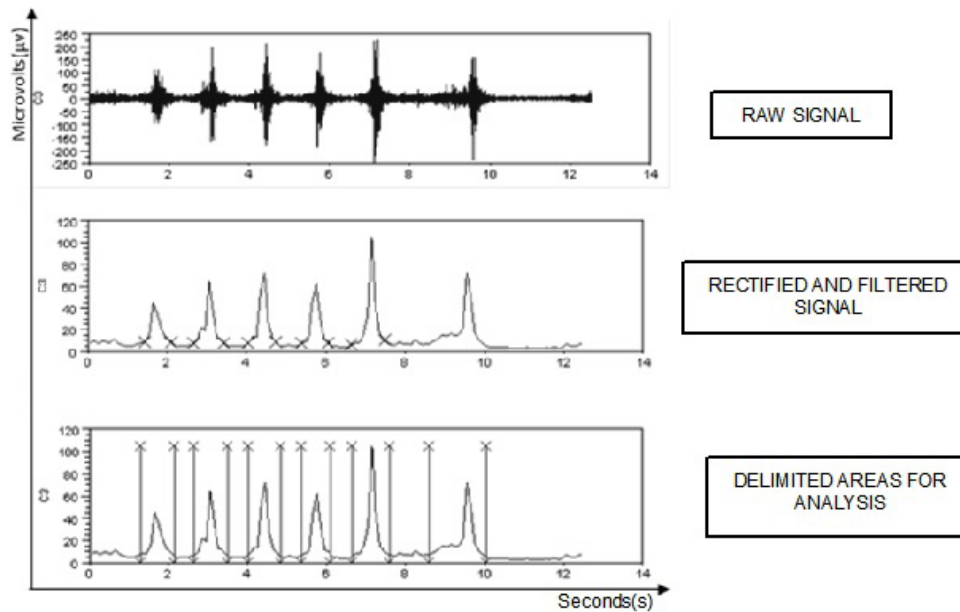
one used for data analysis was the EMG bioanalyzer<sup>BR</sup>, developed by Feodrippe (2010).

The electromyographic signal was amplified 2,000 times, filtered with 20 to 500 Hz band-pass filters, common mode rejection > 120 dB, and a sample frequency of 8000 HZ (2000 Hz for each channel). The electrical activity was picked up with self-adhesive electrodes (Medtrace 200), positioned on the suprahyoid musculature (SHM). Before they were fixed, the skin was cleaned with a gauze damped with 70% alcohol and lightly mas-

saged with abrasive paste (NuPrep) to reduce the impedance of the skin.

To pick up the electrical activity of the SHM, the electrodes were positioned under the chin, 2.5 cm apart from each other; the ground electrode was positioned on the right clavicle, following the recommendations of SENIAM (<http://www.seniam.org/>).

The records were saved in text format (.txt) in the EMG bioanalyzer<sup>BR</sup>, and the raw signal was processed in a rectified and filtered wave through a 100 ms movable window (200 points) (Figure 1).



**Figure 1.** Processing of electromyographic records

### Recording protocol

The recording protocol was developed based on other studies<sup>7-9</sup>. The tests conducted were the swallowing of fixed volumes of water (10 and 20 ml), thin creamy yogurt (5 and 10 ml), and the continuous ingestion of water (100 ml).

The fixed volumes of water and yogurt were measured with a metered syringe. The water content was transferred to a disposable cup and given to the participants. The yogurt was served directly in the participants' mouths. They were instructed to hold the volume in the oral cavity and swallow everything when the EMG operator said "Swal-

low". The 100 ml volume of water was measured and transferred to a disposable cup, then given to the participants. The instruction in this test was: "Drink the water normally, as you do at home".

### Data processing

After processing the raw signal in a rectified and filtered wave in the fixed-volume swallowing tests, the markings were done manually, based on the researcher's visual analysis. The onset was the instant when the activity signal passed the baseline, and the end (the off moment – IOF) was when it returned to the baseline (i.e., its reduction)<sup>10</sup>.

In the 100 ml water continuous ingestion test, the markings were made based on the onset and IOF of each swallowing. Hence, the amplitude analysis was calculated from the arithmetical average of all the instances of swallowing. The total duration was obtained from summing the IOF with the onset in the first swallowing.

### Statistics

In the fixed-volume tests, both of water and yogurt, the variables studied were mean RMS amplitude (in  $\mu\text{V}$ ) and SEMG duration (in seconds). These variables were presented in their mean and standard deviation. Three types of comparisons were made: (1) swallowing 10 and 20 ml of water, (2) swallowing 5 and 10 ml of yogurt, and (3) swallowing 10 ml of water and yogurt.

The statistical analysis was done in the MedCalc software. The statistical significance was tested in the mixed model analysis of variance (ANOVA) – age versus consistency versus volume. The Newman-Keuls test was used for post hoc comparisons. The critical p-value was 0.05.

The amplitude and duration electromyographic measures of the SHM in the tests were established based on the confidence interval obtained from the values in the 5<sup>th</sup> and 95<sup>th</sup> percentiles.

The variables studied in the 100 ml water continuous ingestion test were the number of swallowing efforts made for the ingestion, mean duration of swallowing, and the total duration of the ingestion. These variables were presented in means and standard deviations. The statistical analysis was also done in MedCalc. The significance was tested in the simple model analysis of variance (ANOVA), and the critical p-value was 0.05.

### Results

A total of 49 individuals (36 women and 13 men), the mean age of 72.5 years, participated in the study. The records analyzed summed 47 for the water fixed-volume tests; 46 for the creamy yogurt fixed-volume tests; and 49 for the 100 ml water continuous ingestion test.

Five records were excluded, as their electromyograms presented interferences and noise, which made it impossible to analyze the electrophysiological findings.

The sample was distributed according to age into three groups, namely: Group 1 (G1), comprising older adults 60 to 69 years old, the mean age of 64.1 years; Group 2 (G2), comprising those 70 to 79 years old, mean age of 75.4 years; and Group 3 (G3), comprising those 80 years old or more, mean age of 83.6 years. The following number of records per test were analyzed:

- **For water fixed volume:** 18 participants in G1; 19, in G2; and 10 in G3.
- **For thin creamy yogurt fixed volume:** 16 participants in G1; 18, in G2; and 12, in G3.
- **For 100 ml water continuous ingestion:** 19 participants in G1; 21, in G2; and 9, in G3.

### Amplitudes

The means and standard deviations of the amplitudes of electromyographical activity during the swallowing of 10 and 20 ml of water and 5 and 10 ml of yogurt in the different age groups are given in Table 1.

1<sup>st</sup> comparison: swallowing of 10 and 20 ml of water

In the comparison between the volumes of water, it was found that the amplitude values when swallowing 20 ml was significantly higher than when swallowing 10 ml, in all age groups (ANOVA, main effect for volume:  $p = 0.0091$ ). No significant amplitude differences were found between the age groups (ANOVA,  $p = 0.3768$ ). The interaction between volume and age group was not significant (ANOVA,  $p = 0.0642$ ).

2<sup>nd</sup> comparison: swallowing of 5 and 10 ml of creamy yogurt

In the comparison between the volumes of yogurt, the amplitude values when swallowing 10 ml was higher than when swallowing 5 ml, in all age groups (ANOVA, main effect for volume:  $p = 0.0048$ ). No significant amplitude differences were found between the age groups (ANOVA,  $p = 0.3382$ ). The interaction between volume and age group was not significant ( $p = 0.4883$ ).

3<sup>rd</sup> comparison: swallowing of equal amounts (10 ml) of water and creamy yogurt

In the comparison between consistencies in equal volume, it was observed that the swallowing of creamy yogurt presented significantly



higher amplitude values than that of water, in all age groups (ANOVA, main effect for consistency:  $p = 0.0000$ ). No significant differences were found

between the age groups (ANOVA,  $p = 0.2400$ ). The interaction between consistency and age group was not significant ( $p = 0.7092$ ).

**Table 1.** RMS amplitude ( $\mu\text{V}$ ) of the surface electromyography of the suprahyoid musculature of older adults when swallowing different volumes of water and thin creamy yogurt, by age group.

Age group (years)	Water (n = 47)		Yogurt (n = 46)		10 ml	
	10 ml	20 ml	5 ml	10 ml	Water	Yogurt
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD
60-69	20.8 $\pm$ 9.4	28.7 $\pm$ 13.6	29.1 $\pm$ 8.9	31.0 $\pm$ 12.7	20.8 $\pm$ 9.4	31.0 $\pm$ 12.7
70-79	27.9 $\pm$ 15.1	31.0 $\pm$ 16.6	30.1 $\pm$ 23.8	35.6 $\pm$ 24.5	27.9 $\pm$ 15.1	35.6 $\pm$ 24.5
$\geq 80$	24.0 $\pm$ 12.1	30.1 $\pm$ 14.4	26.8 $\pm$ 12.8	25.7 $\pm$ 9.1	24.0 $\pm$ 12.1	25.7 $\pm$ 9.1
$p^*$	0.0091a		0.0048a		<0.0001b	

Legend: \*ANOVA test; SD - standard deviation; <sup>a</sup> Newman-Keuls with a significant difference in the comparison between volumes; <sup>b</sup> Newman-Keuls with a significant difference in the comparison between consistencies. \*\* $p < 0.05$

### Duration of electromyographical activity

The means and standard deviations of the duration of the electromyographical activities while swallowing 10 and 20 ml of water and 5 and 10 ml of creamy yogurt in the different age groups are presented in Table 2.

1<sup>st</sup> comparison: swallowing 10 and 20 ml of water

A significant difference was found between the age groups (ANOVA, main effect for age group:  $p = 0.0061$ ). The Newman-Keuls post hoc test revealed that the swallowing of older adults 80 years old or more took significantly longer in both volumes of water when compared with the other age groups: 60-69, 70-79 (Newman-Keuls  $p = 0.0027$ ; Newman-Keuls  $p = 0.0012$ , respectively) (Table 2).

2<sup>nd</sup> comparison: swallowing 5 and 10 ml of thin creamy yogurt

There was a significant difference between the age groups (ANOVA, main effect for age

group:  $p = 0.0119$ ). The Newman-Keuls post hoc test revealed that the swallowing of older adults 80 years old or more took significantly longer in both volumes of yogurt when compared with the other age groups: 60-69, 70-79 (Newman-Keuls  $p = 0.0372$ ; Newman-Keuls  $p = 0.0103$ , respectively).

3<sup>rd</sup> comparison: swallowing equal volumes (10 ml) of water and thin creamy yogurt

A significant difference was found in the comparison between 10 ml of water and 10 ml of yogurt (ANOVA, main effect for consistency:  $p = 0.0001$ ); the electromyographic activity lasted longer when swallowing yogurt.

A significant difference was found between the age groups (ANOVA, main effect for age group:  $p = 0.0000$ ). The Newman-Keuls post hoc test revealed that the swallowing of those 80 years old or more lasted statistically longer in both consistencies (water and yogurt) than that of the other age groups: 60-69, 70-79 (Newman-Keuls  $p = 0.0022$ ; Newman-Keuls  $p = 0.0000$  respectively).

**Table 2.** Duration (seconds) of surface electromyography of suprahyoid musculature of older adults when swallowing different volumes of water and thin creamy yogurt, by age group.

Duration (mean ± SD)	Age group (years)			p*
	60-69	70-79	≥80	
Water (n=47)				
10 ml	1.6 ± 0.6	1.5 ± 0.3	2.1 ± 0.6	0.0061 <sup>a</sup>
20 ml	1.5 ± 0.3	1.6 ± 0.4	2.0 ± 0.8	
Yogurt (n=46)				
5 ml	2.1 ± 0.8	2.1 ± 0.6	2.5 ± 1.1	0.0119 <sup>a</sup>
10 ml	2.2 ± 0.8	2.0 ± 0.5	2.8 ± 1.5	
p*	<0.001 <sup>b</sup>	<0.001 <sup>b</sup>	<0.001 <sup>b</sup>	

Legend: <sup>a</sup> Newman-Keuls with a significant difference in the comparison between the age groups ≥ 80 and 60-69 and ≥ 80 and 70-79 for the same volume; <sup>b</sup> Newman-Keuls with a significant difference in the comparison between consistencies. \*\*p < 0.05

### Continuous ingestion of 100 ml of water

The number of instances of swallowing, mean duration of swallowing and mean duration of total ingestion of 100 ml of water are given in Table 3.

The analysis of the continuous ingestion of 100 ml of water did not reveal significant differences between the age groups for the number of instances

of swallowing (ANOVA, p = 0.191), mean duration of swallowing (ANOVA, p = 0.709), and mean duration of the total ingestion of 100 ml of water (ANOVA, p = 0.069). However, the means tended to present an increase in the number of swallowing instances and the mean duration of the total ingestion of 100 ml of water among those 80 years old or more.

**Table 3.** Number of instances of swallowing, mean duration of swallowing, and the total duration of continuous ingestion of 100 ml of water in older adults divided into age groups (n = 49).

Age group (years)	No. of instances of swallowing	Mean duration (s) of swallowing	Total duration (s) of ingestion
	Mean ± SD	Mean ± SD	Mean ± SD
60-69 (n = 19)	5.6 ± 1.5	1.3 ± 0.8	11.6 ± 2.3
70-79 (n = 21)	6.8 ± 1.5	1.0 ± 0.2	12.0 ± 2.8
≥80 (n = 9)	7.6 ± 2.0	1.2 ± 0.3	13.2 ± 4.8
p*	0.191	0.709	0.069

Legend: \*ANOVA test; SD – standard deviation; s – seconds. \*\*p < 0.05

## Discussion

Given the growth of the older adult population, researchers have been studying the behavior of the muscles responsible for the biomechanics of swallowing in senescence through surface electromyography<sup>5,11</sup>. Studies state that the reliability of the electromyographic measures can be influenced by age and different swallowing tests<sup>5,12</sup>. Similarly, the volume and consistency are factors that can change the duration findings, as they affect the way the food bolus is manipulated intraorally<sup>13,14</sup>.

### Electromyographic activity amplitude

An increase in the RMS amplitude means of the SHM was observed in the sample studied, as the volume and consistency increased. It is believed that the amplitude increases or decreases according to the volume ingested because of the central motor programming in response to the physicochemical characteristics of the bolus<sup>13</sup>.

A study conducted with 40 subjects (20 young adults and 20 older adults) to describe the amplitude and time of swallowing based on different consistencies (liquid and creamy) observed higher amplitude values among older adults when

swallowing creamy content when compared to the liquid<sup>15</sup>, corroborating this study's findings.

Although the differences in the values for volume and consistency between the ages were not significant, there was a tendency among those 80 years old or more to present a more reduced amplitude than that of less old adults, when swallowing 5 and 10 ml of creamy yogurt.

Particularly, the increase of adipose tissue on the tongue of the older adults may contribute to attenuate the electromyographic activity, as it increases the impedance of the signal. Nevertheless, it is important to highlight that the amplitude varies according to different factors, such as the thickness of the adipose tissue, duration of rest, speed of contraction, mass and type of the predominant muscle fiber, subtle changes in posture, interelectrode distance, skin impedance, and anatomic-physiological differences between and among subjects<sup>16</sup>.

The electromyographic amplitude of the SHM, in its turn, can be influenced by anatomic-physiological changes due to aging, which is characteristic of presbyphagia. Among these changes, there is the hypotonia of mouth and pharynx musculature; eversion of the lower lip; anterior projection and growth of connective tissue with fat deposited on this structure; reduced mobility of phono-articulatory organs<sup>17</sup>; reduced tongue pressure and lip function, and the consequential decline in swallowing function in older adults<sup>18</sup>.

Few studies with surface electromyography have carried out standardization techniques aiming to reduce variability<sup>12</sup>. Hence, there is yet no consensus on the most adequate technique for functional studies such as that of swallowing<sup>19</sup>.

#### *Duration of electromyographic activity*

In this study, the SHM activity lasted longer when swallowing creamy yogurt in comparison to water. Corroborating these findings, researchers<sup>6,15</sup> found longer SHM electromyographic activity when swallowing creamy content when compared to liquid.

Regarding the comparison between age groups, the older participants had increased duration in all the volumes and consistencies tested. It is known that aging causes a decline in the swallowing mechanism and instability of tongue tip and dorsum, making it take longer to prepare the food. Thus, it is believed that such events can extend the duration of the electromyographic activity of

muscles involved in swallowing, especially in the oropharyngeal phase<sup>8,20</sup>.

The thermal and gustatory sensations also speed oral transit<sup>21</sup>, possibly influencing the electromyographic duration of the suprahyoid musculature. It is known that alterations in taste are part of the physiological process of aging, due to a decrease in specific receptors of gustatory perceptions<sup>20</sup>. Moreover, older adults are more susceptible to adverse or therapeutic effects of medications that potentialize the decrease in these perceptions<sup>22</sup>.

#### *Continuous ingestion of 100 ml of water*

The continuous ingestion, also named free swallowing and sequential swallowing of water, is an easily performed swallowing test, considered the most appropriate test to assess the physiology of this function<sup>8,23,24</sup>. It enables various parameters to be analyzed, such as the number of instances of swallowing during ingestion, mean duration of swallowing, and total electromyographic duration of the ingestion<sup>6,25</sup>.

Although the statistical analysis did not present a significant difference between the age groups, a tendency to increase was observed in the mean duration of total ingestion of 100 ml of water, as well as in the number of instances of swallowing in those 80 years or older. Similar studies found significant increases in the total duration of the ingestion and number of instances of swallowing in adults over 70 years old when compared with younger ones<sup>10,24</sup>.

It is believed that limitations caused by difficulties in selecting healthy older adults and the loss due to electromyographic records with noise and failures in the picking up have influenced the results of the research.

#### **Conclusion**

In the sample studied, the increase in age influenced the duration of the electromyographic activity of the suprahyoid musculature when swallowing, and the creamy consistency of foods influenced the duration and amplitude of this activity, regardless of the age group studied. The electromyographic duration of the suprahyoid musculature proved to be the electrophysiological parameter most influenced by the aging process, lasting longer in adults 80 years old or more.



It is suggested that further studies be conducted with the standardization of the electromyographic signal to reduce the high variability of amplitude.

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