

## Artigo Original

**Thickened Water Ingestion in Healthy Men and Women**  
**Ingestão de Água Espessada em Homens e Mulheres Saudáveis** <http://dx.doi.org/10.18316/sdh.v11i1.9329>

Dauana Cássia Alves<sup>1</sup> ORCID: 0000-0003-0198-3531, Roberto Oliveira Dantas<sup>2\*</sup> ORCID: 0000-0003-2183-0815

**ABSTRACT**

**Objective:** To assess, in men and women without dysphagia, the ingestion of thickened water as used in the treatment of patients with dysphagia. The hypothesis was that they have different dynamics of thickened water ingestion. **Materials and Methods:** A sample of 34 men (mean age 36 years) and 49 women (mean age 33 years) were assessed. In random order, they ingested 100 mL of pure water and 100 mL of water with 1.2 g, 2.4 g, and 3.6 g of food thickener, containing maltodextrin, xanthan gum, and potassium chloride. It was measured the time they took to ingest the whole volume, the number of swallows, the interval between swallows, the ingestion flow, the volume in each swallow, and the self-perceived difficulty ingesting the water. **Results:** Women took longer to ingest the 100 mL in all the water consistencies and had less ingestion flow. Women ingested less volume in each swallow when 1.2 g of thickener was added to the water. There was no difference between men and women in difficulty ingesting the water. The greater consistency increased the time and decreased the flow of ingestion. **Conclusion:** Water ingestion with different consistencies is slower in women than in men.

**Keywords:** Drinking behavior; Deglutition; Sex factors; Dysphagia.

1 Instructor, Paulista University (UNIP), Brazil.

2 Associate Professor, Ribeirão Preto Medical School, University of São Paulo (USP), Brazil.

\*Corresponding author: Av Bandeirantes, 3900, Campus da USP. Ribeirão Preto, SP, Brazil. CEP - 14049-900. Phone: (16) 3626-6285 – Fax: (16) 3602-0229. E-mail: [rodantas@fmrp.usp.br](mailto:rodantas@fmrp.usp.br)

## RESUMO

**Objetivo:** Avaliar, em homens e mulheres sem disfagia, a ingestão de água espessada utilizada no tratamento de pacientes disfágicos. A hipótese era que eles têm diferentes dinâmicas de ingestão de água espessada. **Materiais e Métodos:** Foram avaliados 34 homens (média de 36 anos) e 49 mulheres (média de 33 anos). Em ordem aleatória, eles ingeriram 100 mL de água pura e 100 mL de água com 1,2 g, 2,4 g e 3,6 g de espessante alimentar, contendo maltodextrina, goma xantana e cloreto de potássio. Foi medido o tempo que levaram para ingerir todo volume, o número de deglutições, o intervalo entre as deglutições, o fluxo de ingestão, o volume em cada deglutição e a autopercepção da dificuldade de ingestão da água. **Resultados:** As mulheres demoraram mais para ingerir os 100 mL em todas as consistências e apresentaram menor fluxo de ingestão. Mulheres ingeriram menos volume em cada deglutição quando 1,2 g de espessante foi adicionado à água. Não houve diferença entre homens e mulheres na dificuldade de ingestão. A maior consistência aumentou o tempo e diminuiu o fluxo de ingestão. **Conclusão:** A ingestão de água com consistências diferentes é mais lenta nas mulheres do que nos homens.

**Palavras-chave:** Deglutição; Ingestão de líquido; Sexo; Disfagia

## INTRODUCTION

It has been previously demonstrated that the dynamics of ingestion and swallowing are different between men and women. Although these differences are small and do not impair such functions, it is important to know how they work in both healthy people and dysphagic patients<sup>1-6</sup>. The duration and dynamics of liquid and solid food ingestion and swallowing should be considered when analyzing their physiology.

When patients are being treated for dysphagia, they are often indicated to change the consistency of the liquids they consume, to maintain adequate hydration and nutritional status<sup>7</sup>. This is necessary because low-viscosity liquids are more easily aspirated into the airways<sup>7</sup>, leading to a greater risk of aspiration pneumonia<sup>8</sup>. On the other hand, it is more difficult for people without dysphagia to swallow water in a greater consistency than in its natural liquid state. As the consistency of water increases, it takes longer to ingest it, the ingestion flow decreases, and the perception of ingestion difficulty increases<sup>9</sup>. Thus, the person may ingest less water than they need.

This investigation considered previous studies describing differences between men and women in their ingestion and swallowing<sup>1-6</sup>. Hence, we hypothesize that they have different dynamics when ingesting water as well, both pure and in various consistencies, and different ingestion difficulties – which would be greater in women.

The objective of this research was to study, in men and women, the dynamics of water ingestion in different consistencies.

## MATERIALS AND METHODS

This cross-sectional investigation was conducted in a sample of 34 men and 49 women, aged 18 to 58 years (mean age 33 years for women and 36 years for men), volunteers recruited from the community outside the health system in the same city where the research was performed. All of the volunteers were asymptomatic, do not had swallowing complains, had no diseases, excepted that 47 volunteers have body mass index above 30 kg/m<sup>2</sup> (obesity), were not undergoing any treatment at the time of the assessment, and had no history of surgeries in the upper digestive tract. The women's body mass index ranged from 18.7 kg/m<sup>2</sup> to 60.0 kg/m<sup>2</sup> (mean of 32.9 kg/m<sup>2</sup>), while the men's ranged from 18.6 kg/m<sup>2</sup> to 67.6 kg/m<sup>2</sup> (mean of 33.9 kg/m<sup>2</sup>). None of the volunteers wore dentures. The

research project was approved by the Research Ethics Committee of both the University Hospital and the Ribeirão Preto Medical School at the University of São Paulo, Institutional Review Board (IRB) number 2666/2015. All the volunteers signed the informed consent form before the assessment.

The ingestion of modified water was assessed with a test described in a previous study<sup>9</sup>. It consists of ingesting 100 mL of water at room temperature in four consistencies: one with no food thickener added, and the others with the addition of 1.2 g, 2.4 g, and 3.6 g of food thickener containing maltodextrin, xanthan gum, and potassium chloride (Resource ThickenUP Clear, Nestlé Health Science, Osthofen, Germany). The volunteers sat comfortably on chairs, and the different consistencies of water were offered to them in disposable plastic cups in random order. They were instructed to ingest the whole volume without interruption. We timed the water ingestion with a stopwatch and counted the number of swallows needed to ingest the whole volume, based on the upward movement of the thyroid cartilage<sup>9</sup>. There was a rested time of at least 30 seconds between the assessments with the various consistencies.

It were measured the time they took to ingest the whole volume, the number of swallows per ingestion, the interval between swallows (the time of ingestion divided by the number of swallows), the ingestion flow (100 mL divided by the time of ingestion), and the volume in each swallow (100 mL divided by the number of swallows). After each consistency, the volunteers reported the degree of difficulty ingesting the water, on a linear scale from 0 (zero) to 10 – in which zero is the absence of difficulty, and 10 the most intense difficulty.

The consistencies were classified as follows, based on the International Dysphagia Diet Standardisation Initiative (IDDSI)<sup>10,11</sup>: water without thickener – level 0 (thin); with 1.2 g – level 2 (mildly thick); with 2.4 g and 3.6 g – level 3 (moderately thick).

For statistical analysis, a linear regression model with mixed effects (random and fixed effects) was proposed<sup>12</sup>. Mixed effects linear models are used in data analysis in which responses are grouped (more than one measure for the same individual) and the assumption of independence between observations in the same group is not adequate. These models assume that their residuals have a normal distribution with a mean of 0 (zero) and a constant  $\sigma^2$  variance. In situations where this assumption was not observed, transformations in the response variable were used. For comparisons, the post-test by orthogonal contrasts was used.

The results are presented as mean, standard deviation, and median in the Tables, and as mean and standard error in the figures. The significance level was set at a p-value  $\leq 0.05$ .

## RESULTS

Women took longer than men to ingest the volume of 100 mL of water without thickener (Table 1) and with 1.2 g (Table 2), 2.4 g (Table 3), and 3.6 g of thickener (Table 4) ( $p \leq 0.05$ ).

**Table 1.** Ingestion of 100 mL of water without thickener in men (n = 34) and women (n = 49) without swallowing difficulties.

	MEN		WOMEN		p
	MEAN (SD)	MEDIAN	MEAN (SD)	MEDIAN	
Time (s)	4.9 (1.7)	4.4	6.3 (3.1)	5.4	0.03
Number	4.1 (1.7)	4.0	4.9 (1.8)	4.0	0.20
Interval (s)	1.3 (0.4)	1.2	1.3 (0.3)	1.2	0.75
Flow (mL/s)	23.0 (7.4)	22.6	19.3 (8.2)	18.7	0.03
Volume (mL)	29.4 (15.9)	25.0	23.4 (8.6)	25.0	0.06
Difficulty	0.0 (0.0)	0.0	0.1 (0.4)	0.0	0.93

**Table 2.** Ingestion of 100 mL of water with 1.2 g of thickener in men (n = 34) and women (n = 49) without swallowing difficulties.

	MEN		WOMEN		p
	MEAN (SD)	MEDIAN	MEAN (SD)	MEDIAN	
Time (s)	6.5 (2.8)	6.5	8.7 (4.8)	8.0	0.03
Number	4.9 (2.4)	4.0	6.1 (3.1)	5.0	0.53
Interval (s)	1.4 (0.4)	1.3	1.5 (0.7)	1.3	0.54
Flow (mL/s)	18.8 (9.3)	15.4	13.9 (5.6)	12.6	0.01
Volume (mL)	25.8 (16.4)	25.0	20.2 (10.1)	20.0	0.02
Difficulty	2.5 (2.9)	1.5	1.7 (2.4)	0.0	0.21

**Table 3.** Ingestion of 100 mL of water with 2.4 g of thickener in men (n = 34) and women (n = 49) without swallowing difficulties.

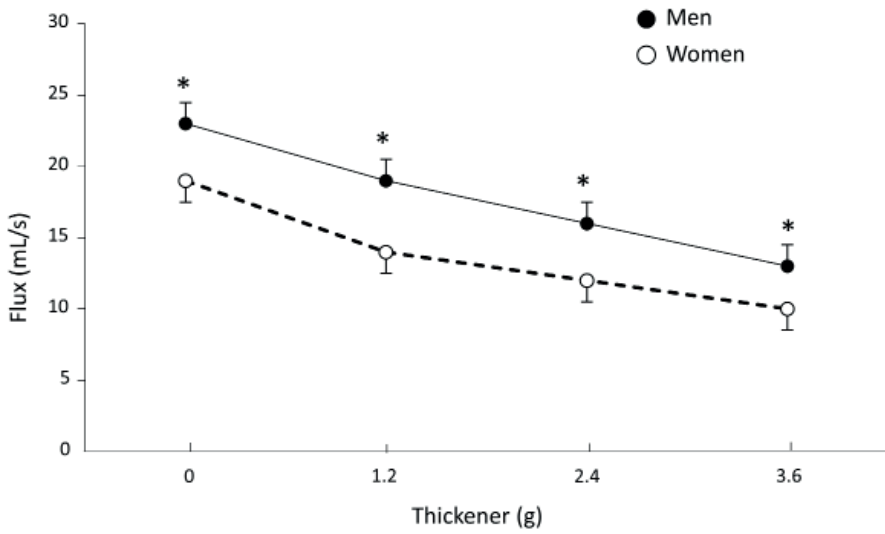
	MEN		WOMEN		p
	MEAN (SD)	MEDIAN	MEAN (SD)	MEDIAN	
Time (s)	8.0 (4.3)	6.7	10.3 (5.1)	9.5	0.03
Number	5.9 (3.0)	5.0	6.3 (2.7)	6.0	0.53
Interval (s)	1.4 (0.5)	1.4	1.7 (0.8)	1.6	0.06
Flow (mL/s)	15.7 (6.9)	15.0	12.4 (6.5)	10.5	0.03
Volume (mL)	22.9 (16.9)	20.0	20.1 (14.2)	16.7	0.33
Difficulty	3.0 (3.3)	2.0	2.7 (3.3)	1.0	0.56

**Table 4.** Ingestion of 100 mL of water with 3.6 g of thickener in men (n = 34) and women (n = 49) without swallowing difficulties.

	MEN		WOMEN		p
	MEAN (SD)	MEDIAN	MEAN (SD)	MEDIAN	
Time (s)	11.4 (8.3)	8.9	12.7 (5.7)	11.4	0.05
Number	6.9 (3.8)	5.5	7.7 (3.5)	7.0	0.22
Interval (s)	1.7 (0.9)	1.5	1.8 (0.8)	1.6	0.77
Flow (mL/s)	13.2 (9.8)	11.2	9.5 (4.4)	8.8	0.05
Volume (mL)	20.3 (16.7)	18.3	15.8 (7.8)	14.3	0.11
Difficulty	4.4 (3.8)	4.0	4.6 (4.2)	3.0	0.69

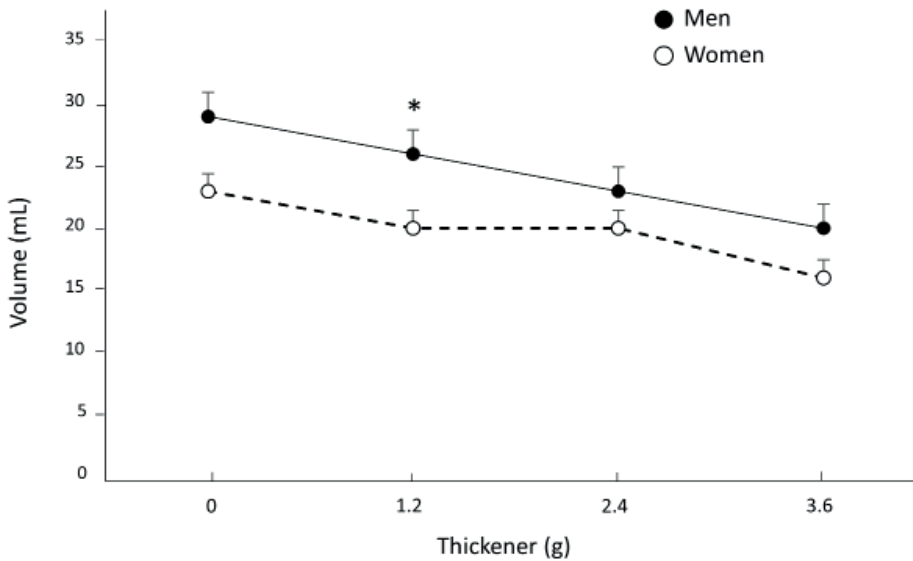
Women had less ingestion flow in all the water consistencies ( $p \leq 0.05$ , Figure 1) and had less volume in each swallow when 1.2 g of thickener was added to the water ( $p = 0.02$ , Figure 2).

**Figure 1.** Flux (mL/s) of water ingestion without thickener and with 1.2 g, 2.4 g, and 3.6 g of thickener in men and women. Mean and SE \* $p \leq 0.05$



The consistency had a similar influence on the ingestion flow of both men and women (Figure 1) – the flow decreased as the consistency increased ( $p = 0.04$ ). In men, the volume in each swallow decreased as the consistency increased ( $p = 0.05$ , Figure 2), as it did in women ( $p < 0.05$ ) – though in these there was no difference when 1.2 g or 2.4 g of thickener was added to the water ( $p > 0.05$ ).

**Figure 2.** Volume (mL) in each swallowing of water without thickener and with 1.2 g, 2.4 g, and 3.6 g of thickener in men and women. Mean and SE \* $p = 0.02$



There was no difference between men and women in the assessment of difficulty swallowing water with the several thickener concentrations ( $p > 0.20$ , Tables 1 to 4).

## DISCUSSION

Differences between men and women regarding their oral and pharyngeal phases of swallowing have been described. Water ingestion tests without thickener, following the same method of this investigation, have already observed that women had less flow and volume in each swallow and took longer to ingest<sup>2</sup>. Women have more chewing cycles and chew for longer than men<sup>13</sup>. The capacity to accommodate liquid volume in the oral cavity is greater in men than in women<sup>14</sup>, which may be due to men's larger orofacial measures<sup>15,16</sup>.

The interval between the beginning of the electromyography of the suprahyoid musculature and the pharyngeal elevation is longer and the pharyngeal elevation is faster in men than in women<sup>4</sup>. Women ingest solid foods more slowly (in grams per second), probably because their bite size is smaller<sup>3</sup>. Men have larger sip volume and larger pharyngeal area at rest than women<sup>17</sup>. The maximum isometric pressure in mouth opening<sup>18</sup> and the maximum anterior and posterior tongue pressure is also higher in men than in women<sup>19</sup>.

Videofluoroscopic swallowing assessment in men and women reveals a long oral transit and a long pharyngeal clearance in women<sup>5</sup>, which agrees with the results. Slow mouth and pharyngeal transit may be the cause of less water flow during ingestion. There is a wide range of results in transit measures and, in some samples, the difference between men and women may not have a statistical significance<sup>20</sup>.

No difference was observed between men and women in either the esophageal transit time<sup>21</sup> or esophageal body contractions<sup>22</sup>. However, immediately below the upper esophageal sphincter (where the musculature is striated, different from the middle and distal parts of the esophagus, where the musculature is smooth), the esophageal contractions last longer in women<sup>23</sup>. Also, the integrated relaxation pressure (IRP) in the esophageal-gastric transition is higher in women than in men<sup>24</sup>, indicating less relaxation in women's lower esophageal sphincter than in men.

Changing water consistency is an important option when treating dysphagic patients, to avoid liquid aspiration into their airways and maintain hydration in those who cannot ingest pure water<sup>7</sup>. Thickeners do not reduce the bioavailability of water; however, they reduce water ingestion and might consequently lead to dehydration<sup>25,26</sup>. Water with thickener added is more difficult to ingest<sup>9,26</sup> and is not well-received by all patients<sup>25,27</sup>. However, such difficulty and acceptance<sup>26</sup> are not different between men and women. The reference in both sexes is that the changed diet causes texture and taste dissatisfaction<sup>9,27</sup>.

The difference observed between men and women in the ingestion of no modified and modified water may be a consequence of anatomical and functional differences between the sexes<sup>14-16,28,29</sup>. Knowing this difference may help caregivers of dysphagic people develop the habit of feeding women more slowly than men. Women need more ingestions and swallows to consume a given volume of food than men – which means less volume of food in each swallow<sup>6</sup>. Dysphagic patients or their caregivers must wait for multiple swallows before putting another amount of food in the mouth – and they must be particularly careful in the case of women<sup>6</sup>. Furthermore, the viscosity of the thickened liquids may change in the oral cavity. The longer they remain in the oral cavity, the more the bolus temperature increases, and the bolus viscosity decreases<sup>30</sup> – which may not follow the therapeutic prescription.

This study has limitations. Solid foods could be assessed – necessarily on different days from the assessment with liquids, as each volunteer ingested altogether 400 mL of liquid. Each volunteer's orofacial measures might have influenced the results, but they were not taken. Men have larger orofacial anthropometric measures than women<sup>15,16</sup> though without significant influence of the body height<sup>15</sup>. Some of the volunteers were obese; nevertheless, the groups had similar overall body mass index, and obesity does not influence the parameters measured in the investigation<sup>9</sup>. Age influences, though only after 65 years old<sup>6</sup>.

## CONCLUSION

Women ingest water in different consistencies more slowly than men and, therefore, have less ingestion flow.

## Author contributions

DCA: Participated in organizing the investigation, collecting, and analyzing the data, writing the manuscript, and deciding to submit the manuscript for publication.

ROD: Participated in organizing the investigation, collecting, and analyzing the data, writing the manuscript, and deciding to submit the manuscript for publication.

## Conflict of Interest

The authors DC Alves and RO Dantas declare that there is no conflict of interest related to this manuscript. Dr. Roberto O Dantas is a member of the Board of Directors of the International Dysphagia Diet Standardisation Initiative (IDDSI).

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