

Changes in Tongue Strength and Endurance after a Typical Meal in Healthy Older Adults in a Continuing Care Community

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Abstract. The ability to swallow safely is vital for nourishment of the body and brain and depends on adequate tongue function, particularly strength and endurance. *Purpose:* Investigate changes in tongue strength and endurance in healthy older adults (65⁺ years). *Methods:* Self-reported healthy older adults ($n = 20$; 15 women, 5 men) completed tongue strength and endurance measures before and after a regular lunch using the *Iowa Oral Pressure Instrument (IOPI)*. *Results:* A paired samples *t*-test documented a statistically significant increase ($p < 0.05$) in tongue strength following the meal. This contrasts with published data using highly textured food and suggests that a regular, but less textured, meal may provide sufficient resistance for tongue function without generating undue fatigue and diminished strength.

1. Introduction

Aging affects all physiological processes. [1, 2] The expected changes in these processes (i.e., healthy aging) can be compounded by disease-related conditions (e.g., stroke). One particular area of difficulty that can be associated with both healthy and disease-related aging is that of swallowing. Being able to swallow safely is vital for adequate nourishment and hydration. [3, 4] A primary component of a safe swallow is tongue function, particularly strength and endurance. [2, 5, 6] Recent published data have documented a decline in tongue strength and endurance following a highly textured meal (half of a bagel spread with 1 tablespoon of creamy peanut butter, 8 baby carrot sticks, and 8 ounces of 2% chocolate milk) in healthy adults, both young and older. [2, 5] However, many older adults in a Continuing Care Retirement Community (CCRC) do not regularly consume such challenging foods. A typical meal in a CCRC cafeteria consists of a buffet with a choice of two meat entrees in sauce, cooked vegetables, salad, and dessert.

The current study addressed changes in tongue strength and endurance using a regular, but less textured, meal in contrast to the highly textured meal used in published studies. With the number of older adults (65⁺ years) increasingly rapidly, the prevalence of swallowing disorders (dysphagia) is likely to increase in this population whether adults are aging in a healthy, or disease-related manner. [2, 7] Documenting baseline data for tongue strength and endurance in healthy older adults in a CCRC following a *typical* meal provides vital information for potential decline in function and subsequent intervention.

Purpose: To investigate tongue strength and endurance in self-reported healthy older adults living in a CCRC before and after a typical meal.

2. Experiment, Results, Discussion, and Significance

Methods: Participants were 20 self-reported, healthy, older adults (mean age = 85.75 years, ± 5.33). There were 15 women (mean age = 85.73 years, ± 5.30) and 5 men (mean age = 85.80 years, ± 6.04). All were residents in Independent Living at the Kansas Masonic Home (KMH). Following IRB approval from Wichita State University and KMH, each participant gave their written Informed Consent. All participants had a passing score of 21⁺/30 on the *Mini-Mental State Examination (MMSE)* confirming their cognitive ability to understand the purpose of the testing and provide agreement to participate. [8, 9]

The *Iowa Oral Pressure Instrument (IOPI)* [10] was used to document tongue function in two ways: (a) maximal tongue pressure (P_{\max}) in kPa, and (b) endurance (50% P_{\max} in seconds). The *IOPI* has a small plastic bulb that is attached to a programmable device. To obtain maximal tongue pressure (a measure of tongue strength), participants were asked to place the *IOPI* bulb in the mouth on the anterior-mid portion of the tongue. Participants then were instructed to apply maximal static pressure (i.e., “push as hard as you can”) with their tongue to push the bulb up and against the anterior region of the hard palate (immediately posterior to the dento-maxillary ridge) for 1-2 seconds. Three trials were conducted. A 30 second rest between trials was provided. The highest pressure

measurement from the three trials was considered P_{max} . The measurement of P_{max} then was programmed into the *IOPI*. To obtain tongue endurance, the *IOPI* bulb again was placed on each participant's tongue and participants were asked to push the bulb against the hard palate and hold it there at 50% of P_{max} for as long as they could. To assist participants with this task, the *IOPI* displayed a red-yellow-green light continuum. The green light area equaled the participant's programmed 50% of P_{max} value.

Following the first set of *IOPI* measurements, each participant consumed a *typical* lunch provided by the KMH cafeteria. Immediately following the completion of the lunch, each participant's tongue strength and endurance were retested using the previously stated *IOPI* protocol.

Results: There was a statistically significant increase of 3.5 kPa in tongue strength following the meal [$t(19) = -2.49, p = 0.02$]. An increase of 2.5 seconds in tongue endurance following the meal was not statistically significant [$t(19) = -0.75, p = 0.46$].

Discussion: A commonly accepted approach to maintain skeletal muscle strength and endurance in healthy older adults is to have them work against increasing resistance. [11] Eating is a form of resistance and tongue action (force) against resistance (food) is needed to maintain an effective and safe swallow. Using the *IOPI* and a meal of challenging textures, Kays et al. documented a decrease in pre-to-post-meal tongue strength and endurance in healthy older adults. [5] However, such a meal is not typical for older adult residents in CCRCs. Results of the current study suggest that eating a regular, but less textured, meal may provide sufficient resistance for tongue function without generating undue fatigue and diminished strength in older adults. The presence of upper dentures also may facilitate tongue strength. [12] It is currently unknown whether older adults in residential care wear upper dentures more than healthy older adults in the community. Results, if confirmed, raise clinical implications regarding careful diet modification for older adults with swallowing difficulties and the need for regular and systematic re-evaluation of food textures when diet modification has been implemented.

3. Conclusions

After consuming a *typical* lunch in a supportive care environment, the tongue strength of a group of self-reported healthy older adults increased significantly. This contrasted with the reported decline in tongue strength in healthy older adults after eating a more textured meal. Further research is necessary to determine the ideal texture of foods for older adults to provide optimal resistance for maintaining tongue strength and endurance.

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5. References

- [1] McHorney, C. A., Martin-Harris, B., Robbins, J., & Rosenbek, J. (2006). Clinical validity of the SWAL-QOL and SWAL-CARE outcome tools with respect to bolus flow measures. *Dysphagia*, 21(3), 141-148.
- [2] Robbins, J., Gangnon, R. E., Theis, S. M., Kays, S. A., Hewitt, A. L., & Hind, J. A. (2005). The effects of lingual exercise on swallowing in older adults. *The American Geriatrics Society*, 53(9), 1483-1489.
- [3] Puisieux, F., D'andrea, C., Baconnier, P., Bui-Dinh, D., Castaings-Pelet, S., Crestani, B., ... Weil-Engerer, S. (2009). Swallowing disorders, pneumonia and respiratory tract infectious disease in the elderly. *Revue des maladies respiratoires*, 26(6), 587-605 [Abstract in English].
- [4] Schweizer, V. (2010). Swallowing disorders in the elderly. *Revue medicale suisse*, 6(265), 1859-1862 [Abstract in English].
- [5] Kays, S. A., Hind, J. A., Gangnon, R. E., & Robbins, J. (2010). Effects of dining on tongue endurance and swallowing-related outcomes. *Journal of Speech, Language, and Hearing Research*, 53, 898-907.
- [6] Fiatarone, M. A., & Evans, W. J. (1993). The etiology and reversibility of muscle dysfunction in the aged. *Journal of Gerontology*, 48 (Special Issue), 77-83.
- [7] Yeates, E. M., Molfenter, S. M., & Steele, C. M. (2008). Improvements in tongue strength and pressure-generation precision following a tongue-pressure training protocol in older individuals with dysphagia: Three case reports. *Clinical Interventions in Aging*, 3(4), 735-747.
- [8] Folstein, M. F., Folstein, S. E., & Fanjiang, G. (2001). MMSE: Mini-Mental State Examination. *Clinical Guide*. Lutz, FL: Psychological Assessment Resources, Inc.
- [9] Milman, L. H., Holland, A., Kaszniak, A. W., D'Agostino, J., Garrett, M., & Rapcsak, S. (2008). Initial validity and reliability of the SCCAN: Using tailored testing to assess adult cognition and communication. *Journal of Speech, Language, and Hearing Research*, 51, 49-69.
- [10] Robin, D.A., Goel, A, Somodi, L.B., & Luschei, E.S. (1992). Tongue strength and endurance: Relation to highly skilled movements. *Journal of Speech and Hearing Research*, 35, 1239-1245.
- [11] Pearce, A. J., Roweb, G. S., & Whyteb, D. G. (2012). Neural conduction and excitability following a simple warm up. *Journal of Science and Medicine in Sport*, 15(2), 164-168.
- [12] Aki, S., Nakamura, F.J., Abe, R., Ono, T., & Suzuki, T. (2012, March). Compensatory effect on tongue-palate contact during swallowing by wearing palatal plate for experimental enlarged oral cavity. *Dysphagia Research Society*, Toronto, CA.