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Original article

The effect of tongue strength on meal consumption in long term care

Ashwini M. Namasivayam [a, b, c, *], Catriona M. Steele [a, b, c, d, e], Heather Keller [f]

[a] Toronto Rehabilitation Institute, University Health Network, 550 University Avenue, Toronto, ON M5G2A2, Canada
[b] Speech-Language Pathology, University of Toronto, 500 University Avenue, Toronto, ON M5G1V7, Canada
[c] Rehabilitation Sciences Institute, University of Toronto, 500 University Avenue, Toronto, ON M5G1V7, Canada
[d] Institute for Biomaterials and Biomedical Engineering, University of Toronto, Canada
[e] Bloorview Research Institute, Canada
[f] Schlegel Research Chair, Nutrition & Aging, Schelgel-University of Waterloo Research Institute for Aging, University of Waterloo, Canada

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SUMMARY

Purpose: As many as 74% of residents in long-term care (LTC) are anticipated to have swallowing difficulties (dysphagia). Low food intake is commonly reported in persons with swallowing problems, but food intake may also be affected by fatigue in the swallowing muscles. As fatigue sets in during mealtimes, the strength of the tongue may decline. Tongue strength is also known to decline with age but it is unclear how this functional change may influence food intake. In this pilot study, we explored the relationship between tongue strength and meal consumption in persons not previously diagnosed with dysphagia.

Methods: The Iowa Oral Performance Instrument was used to collect maximum anterior isometric tongue-palate pressures from 12 LTC residents (5 male; mean age: 85, range 65–99). Residents were also screened for dysphagia with applesauce and a water swallow test. Each resident was observed at three different meals to record the length of time taken to eat the meal, amount of food consumed, and any indication of overt signs of swallowing difficulty (e.g. coughing).

Results: Residents who displayed observable swallowing difficulties at mealtimes had significantly lower tongue strength than those without swallowing difficulties ($p < 0.01$). Those with lower tongue strength took significantly longer to complete meals ($p < 0.05$) and consumed less food. Tongue strength was not predictive of performance on the water screen and the water swallow test was not a good predictor of which participants were observed to display mealtime difficulties.

Conclusion: Among seniors in long term care, reduced tongue strength is associated with longer meal times, reduced food consumption, and the presence of observable signs of swallowing difficulty. Further exploration of these relationships is warranted.

1. Introduction

Elderly adults living in long term care (LTC) facilities (including nursing homes and assisted living), are nutritionally vulnerable. Inadequate food and fluid intake leads to malnutrition. Malnutrition is estimated to be present in 30–60% of those living in LTC, with negative consequences for health, well-being, quality of life (QOL) and health care costs [1]. Malnutrition can also lead to serious illnesses, which may call for hospitalization. In Canada, admissions from LTC account for approximately 10% of all acute care hospital visits [2]. As the baby-boomers age, an increased demand for LTC beds is anticipated [3]. In the European Union (EU), elderly people currently account for approximately 18% of the population [4] and the old-age dependency ratio (i.e., the number of people over 65 divided by the number of people aged 15–64) is expected to reach 53% by 2050 (up from 25% in 2007) [5]. These demographic changes will place serious pressures on the health-care system, which will be exacerbated by malnutrition unless effective solutions for poor food intake in LTC are found. In order to limit and mitigate the costs associated with malnutrition, it is critical that we determine the factors associated with and contributing to poor food intake and malnutrition among those residing in LTC.

* Corresponding author. Toronto Rehabilitation Institute, University Health Network, 550 University Avenue, Toronto, ON M5G2A2, Canada. Tel.: +1 416 597 3422.
E-mail address: Ashwini.namasivayam@mail.utoronto.ca (A.M. Namasivayam).

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Poor food and fluid intake is the primary cause for LTC malnutrition; average consumption has been estimated at 50% of food offered [[6] 2003]. Dysphagia (swallowing difficulty) is also a known comorbidity for those in LTC, and estimated to be present in as many as 74% of residents [7,8]. There is an even higher prevalence of dysphagia in those with dementia [9], who comprise a large proportion of LTC residents. Residents with dysphagia are at increased risk for inadequate food intake, leading to malnutrition [10]. Food intake may also be affected by eating-related fatigue [11] and this may be of particular concern in seniors with dysphagia, who are reported to take longer to eat [12].

The tongue is a critical organ in swallowing, providing the driving forces that transport food and liquid through the mouth and pharynx. Fatigue in the tongue muscles may contribute to incomplete food clearance (residue), prolonged time to complete a meal and reduced intake. In a study by Kays and colleagues [13] the tongue strength of older, healthy adults (aged 65–82) was measured twice at baseline and once following consumption of a meal. The results showed that the activity of eating a meal can be tiring enough to cause a reduction in post-meal measures of tongue strength compared to pre-meal measures. Previous studies have also shown that tongue pressures are generally lower in healthy older adults when compared to healthy younger adults [14–18], and reduced tongue strength is associated with aspiration (i.e., entry of material into the airway, contributing to the risk of respiratory consequences) [19]. However, we do not know the extent to which tongue strength impacts food intake in elderly individuals living in LTC. If an age-related reduction in tongue strength increases the demands of dining for those in LTC, we may see longer mealtimes, leading to reduced intake and contributing to malnutrition risk.

The goal of the current pilot study was to explore tongue strength in elderly residents in a LTC facility and to measure its association with: (a) signs of swallowing impairment based on a dysphagia screening tool; (b) length of time to eat a meal; (c) signs of swallowing impairment observed during meals; and (d) amount of food consumed. The study was also conducted to establish feasibility of collecting these measures in a larger, future study. We hypothesized that those with reduced tongue strength would be more likely to demonstrate signs of swallowing impairment on the dysphagia screening tool, take longer to finish eating, show signs of swallowing impairment during meals, and eat less than residents with tongue strength within the reported norms.

2. Materials and methods

2.1. Participants

A pilot sample of 20 elderly residents (8 male, 12 female; mean age: 85, range 65–99) was recruited from a LTC facility in Waterloo, Canada as part of a larger project exploring predictors of malnutrition. Informed written consent was obtained directly from LTC residents who had the capacity to consent as identified by unit staff. For residents who did not have the capacity to provide informed consent, unit managers or designates approached substitute decision makers using a standard script for permission to provide their contact information to the researchers. In the cases where a substitute decision maker provided consent for participation, assent to participate in the study was evaluated by the willingness of residents to cooperate with data collection procedures. The inclusion and exclusion criteria for participants can be found in Table 1.

A subset of these 20 pilot participants was recruited to perform the swallowing screening and tongue strength measures. In total, twelve elderly adults (5 male, 7 female; mean age: 85, range 65–99) made up this smaller group of residents. The inclusion criteria for this subset can be found in Table 2.

2.1.1. Swallowing screening and tongue strength

Each participant in the study was screened for dysphagia by a licensed speech-language pathologist (SLP) using a modified version of the Screening Tool for Acute Neurological Dysphagia (STAND) [20]. This tool evaluates a participant's risk of dysphagia using pureed fruit (Mott's ® Fruitsations Unsweetened Applesauce) and water (Nestle ® Pure Life Bottled Water). The modifications adopted for the purposes of this pilot study were as follows:

1) Each participant was asked to repeat the initial task of swallowing a teaspoon of puree (applesauce) three times to ensure representative sampling of swallowing behavior. The puree task was discontinued if any difficulties were noted.
2) Two saliva swallows were elicited after completion of the puree trials, regardless of the number of puree trials completed. Thicker consistencies are known to cause increased residue [21]; therefore, these saliva swallows were included for the purpose of clearing any residue prior to the water swallow portion of the test.
3) A single 3-ounce water swallow trial was performed, requiring residents to drink water from a cup. The additional straw-drinking 3-ounce water swallow trial specified in the original STAND protocol was omitted.
4) Oxygen saturation levels were not monitored, and tearing in the eyes was not used as a sign of swallowing difficulty since these signs have not been found to be valid indications of swallowing impairment in the broader swallowing literature [22,23].
5) Lastly, the observation of more than two swallows per bolus was added as a sign of swallowing difficulty [24].

Measures of tongue strength were taken by the SLP using the Iowa Oral Performance Instrument (IOPI). The IOPI is a handheld manometry system that consists of a 2.7 ml air-filled bulb that is squeezed between the tongue and the hard palate (see Fig. 1). Pressures are displayed on the device LCD screen, in kilopascals. The bulb is attached to the IOPI machine with a small, clear connector tube, which also prevents the bulb from being swallowed accidentally. A clean, individually wrapped, single-use tongue pressure bulb was used for each participant, and disposed of immediately after use. In consultation with the manufacturer, we have developed a Microsoft Excel software program to register a digital pressure waveform from the analog signal generated by the IOPI at 250 Hz. This enables us to provide a biofeedback screen view of the tongue pressure measurement to the participant during data collection and to extract detailed measures of tongue pressure amplitude and timing from the recorded waveform (Fig. 2). Both maximum anterior isometric tongue strength pressures (squeezing the bulb between the front of the tongue and the hard palate as hard as possible) and saliva swallow pressures (keeping the bulb at the front of the tongue while swallowing saliva) were collected three times from each participant. Each participant was allowed to practice two times before any data were collected. Tongue pressure tasks were cued with a 10 s rest between each task repetition; total time to complete these tasks was three to 5 min.

Swallowing screening and tongue pressure tasks were completed in a single session for all residents. Measures were taken between meals and typically in the morning when residents were most alert. The unit kitchen served as the most accessible place to complete all of the tasks. Any participants who were unwilling or unable to follow the instructions to perform the tasks were excluded.

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