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Feature Article

Impact of self-tongue brushing on taste perception in Thai older adults: A pilot study

Jirakate Madiloggovit, DDS [a], Nattida Chotechuang, PhD [b], Dunyaporn Trachootham, PhD [c,*]

[a] Faculty of Dentistry, Thammasat University, Pathum-thani, Thailand
[b] Department of Food Technology, Faculty of Science, Chulalongkorn University, Bangkok, Thailand
[c] Institute of Nutrition, Mahidol University, 999 Phutthamonthon 4 Rd., Salaya, Phutthamonthon, Nakhon Pathom 73170, Thailand

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ABSTRACT

Oral hygiene influences taste, affecting appetite and nutrition in older adults. However, the impact of self-administered tongue brushing on their taste perceptions was unclear. This pilot study ($N = 44$) was aimed to observe the changes in taste thresholds using Filter Paper Disc after tongue brushing in Thai older adults. Based on the results, continuous tongue brushing for 3 months reduced tongue coat ($p < 0.01$) and improved subjective taste in 74% of participants. Sweet and salty recognition thresholds were reduced in both anterior and posterior tongue, while sour and bitter thresholds were reduced only in posterior tongue. No changes in umami (savory) were observed. Daily brushing was more effective than weekly brushing in improving the sweet and bitter tastes. The data suggested that tongue brushing could improve perception of multiple tastes and daily tongue brushing was recommended as routine personal care for older adults. This study supports further investigation in a randomized-controlled setting.

Introduction

Taste alteration is a common complaint in older adults worldwide.[1] It is estimated that taste perception in older adults decreases to about half that of young adults.[1] Owing to the role of taste as a major sense of eating, taste alteration leads to reduced appetite, decreased food intake, malnutrition and, consequently, poor quality of life.[2] Furthermore, a decrease in taste perception can lead to unhealthy food choices.[3,4] For example, high thresholds of salty and sweet tastes may increase the intakes of sodium and sugar, respectively. And this behavior can increase risks of heart disease, hypertension, obesity and diabetes mellitus.[4] The direct impacts of taste disturbances on general health are well-evident. Declines in smell and taste are major contributors of anorexia, malnutrition and weight loss in aging populations.[5] A study of nursing home residents showed that loss of appetite might reduce protein intake, decreased blood albumin level and subsequently impaired immune function.[1] Age-related anorexia is associated with protein-energy malnutrition, sarcopenia, frailty, functional deterioration, morbidity, and mortality.[5] In fact, a recent study showed that taste impairment was strongly associated with the mortality of acutely hospitalized older adults.[6] Based on the importance of taste, any new strategies to reduce taste thresholds will certainly have impact on food intake, nutrition and general health of older adults.

Although taste thresholds could increase with age,[7] the actual cause of taste alteration in older adults likely involves multiple factors such as systemic diseases (e.g. cancer and stroke), decreased salivary flow and side effects of radiation and medications.[8,9] Recent evidence suggests that oral health status is another important factor affecting taste sensitivity.[10] Accumulation of oral bacteria in patients with dental caries and poor oral hygiene were associated with an increase of taste thresholds and poorer taste perception.[10] Since most taste buds are distributed throughout the tongue, accumulation of bacterial plaque as tongue coat may cover the taste pores and prevent binding between taste substances and receptors.[11,12] A previous report showed that tongue coat was associated with taste disturbances.[13] Unlike tooth brushing, removal of tongue coat by tongue brushing is not routinely recommended as part of personal care in most guidelines of nursing care.[14] Therefore, tongue coat is commonly seen in older adults

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* Corresponding author. Tel.: +66 2 800 2380x326; fax: +66 2 441 9344.
E-mail address: dunyaporn.tra@mahidol.ac.th (D. Trachootham).

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and more likely responsible for taste alteration.[15] A systemic review showed that tongue coat and intra-oral halitosis (mouth odor) were significantly reduced after tongue cleaning.[14] Furthermore, a prospective study of Japanese older adults at a nursing home demonstrated that tongue cleaning by the nurse every day resulted in a significant reduction of Candida scores in tongue coating.[16] Similarly, another Japanese study showed that mild tongue brushing by professional nurses might improve salty and sour taste recognition of older adults.[17] Furthermore, a Belgian study of young adults with habitual oral hygiene showed that tongue brushing or scraping twice daily for two weeks significantly reduced the amount of tongue coating and improved bitter and salty taste sensitivities.[18] However, it is unclear if self-administered tongue brushing by older adults can improve their taste perceptions.

Thai cuisine is famous for its spiciness and is unique in its variety of flavors in one dish.[19] Most Thai dishes contain a mixture of flavors from natural ingredients. For example, Tom-Yam-Kung soup has sour taste from tomato and lime juice, sweet taste from red onion and roasted chili paste, salty and umami taste from shrimp and fish sauce, and bitter taste from lemongrass and kaffir leave. This characteristic is different from other cuisines such as Japanese, where one dish mostly has a single flavor but one meal is often served with multiple side dishes.[20] Western cuisines are milder in flavor and usually served in order from appetizer to main course and dessert. Thai dinner meals often contain Jasmine rice and at least two dishes all served together (even the spicy salad).[19] Furthermore, distinct seasonings are also used in Thai food[21]; for example, fish sauce, soy sauce, or salt may be used for salty taste and lime, tamarind, or vinegar for producing sour taste. Fermented protein products, containing high level of glutamate, are also widely used to season the food.[21] Due to the unique nature of Thai cuisines, taste thresholds of Thai people likely have interesting patterns. A previous study in community-dwelling Thai older adults found a significant association between taste disturbances and hyposalivation.[22] However, the thresholds of taste perception in Thai older adults and the effect of tongue brushing on taste thresholds in this population had never been reported. Therefore, the aim of this pilot study was to observe the changes in recognition and sensitivity taste thresholds of sweet, sour, salty, bitter and umami taste in Thai older adults before and after their continuous self-administered tongue brushings.

Materials and methods

Materials

Tongue brushes were obtained from GC Asia (Singapore). Filter Paper Disc (FPD) test kits were gifts from Dr. Hisayuki Uneyama and Dr. Misako Kawai. The commercial FPD kit is composed of taste solutions (five concentrations of each): sucrose, sodium chloride, tartaric acid and quinine hydrochloride for sweet, salty, sour and bitter taste, respectively.[23] For umami taste, six concentrations of monosodium glutamate (MSG) solution were prepared in distilled water and filtered through 0.2 μm pore prior to use, as described by Satoh-Kuriwada et al.[24] The concentrations are depicted in Fig. 1A.

Participants

Participants were recruited from the outpatient dental clinic of Thammasat University Hospital, Thailand. Prior to the recruitment, all participants were screened based on the following inclusion criteria: being at least 55 years old; born and resided in Thailand for at least 10 continuous years; having no history of systemic diseases or having well-controlled systemic diseases. Exclusion criteria were as follows: having oral candidiasis; complete loss of all taste; cannot tolerate FPD test; unable to make reliable decision or communication; cannot return to follow-up at 3 months. All participants signed their written informed consent prior to data collection. Their identities have been protected, following ICH-GCP.

Sample size calculation

The sample size of this study was identified by priori power analysis using G Power 3.1. The effect size was calculated from pilot data using mean recognition thresholds and standard deviation of 10 participants at baseline and 3 months after tongue brushing. The effect size was 0.56. Based on Wilcoxon-signed rank test, we needed to enroll 38 participants to achieve 90% power at two tailed and alpha level of 0.05. Initially, 60 volunteers were screened; 55 of them passed the criteria. Finally, complete data were from 44 patients. The 20% dropout was due to loss of follow-up.

Study procedures

This study was approved by the institutional ethics committee for research in human of Thammasat University, Thailand and performed according to the Declaration of Helsinki. This pilot study was conducted using a prospective observational study with pre-post design. At the beginning, all patients who passed the inclusion criteria and signed the written informed consent had received history taking, oral exam for tongue coat and baseline measurement of recognition and sensitivity taste thresholds. Then, each patient received a tongue brush and demonstration for use. They were educated about the importance of tongue brushing and encouraged to routinely brush their tongues once a day. After 3 months of tongue brushing, tongue coat, recognition and sensitivity taste thresholds of the anterior and posterior tongue area (measured by Filter Paper Disc), were compared with baseline data. Furthermore, frequency of tongue brushing and subjective feeling of taste improvement was evaluated. Telephone surveys were performed monthly over a 3 month period to monitor the patients' tongue brushing habits.

Outcome

The primary outcome was measured tongue coat and recognition thresholds of sweet, salty, sour, umami and bitter taste. The secondary outcomes were measured sensitivity thresholds of sweet, salty, sour, umami and bitter taste, and subjective feeling of taste improvement. All measurements of outcome for each participant were performed in the dental clinic by a professional dentist.

Tongue coat

The participants were examined by a dentist for tongue coat. The scores were given as: 0 = none; 1 = a bit (plaque covering less than half of the tongue); 2 = heavy (covering more than half of the tongue).

Recognition and sensitivity taste threshold

The thresholds were measured by the Filter Paper Disc method as described by Satoh-Kuriwada et al[24] A round filter paper disc (0.5 m diameter) was briefly immersed in a taste solution, then placed for 3 s on the right anterior (near the tip) or left posterior (near the tonsil) part of tongue, as shown in Fig. 1B. Then, the paper disc was removed and the participants were asked to swallow their saliva immediately in order to distribute taste substance. Finally, the participants answered whether they had perceived any taste and provided the name of the taste. Each participant would begin from the lowest concentration of each taste then continue to higher