Abstract

Taste loss is a major contributor to malnutrition and unintentional weight loss in elderly people. The primary objective of this review is to compare research via the EBSCO and Web of Science databases which identifies potential etiologies for this decreased taste acuity that often accompanies increased age. Contrary to popular belief, this review found evidence that olfactory function may not significantly cause taste bud dysfunction. But, these articles together suggest mechanisms by which the ability to sense taste is reduced including zinc deficiency, poor oral hygiene, inflammation, and increased use of medication. These findings offer medical practitioners information regarding development of optimal treatment plans for older adults with anorexia related malnutrition. Due to the various possible mechanisms, accurate patient assessment is essential to identify the best course of treatment.
INTRODUCTION

As the age demographic in developed countries such as the United States shifts toward an older population, it is becoming increasingly important for medical practitioners to be familiar with means to properly care for the complications which accompany aging. By 2020, it is likely that the percent of people over the age of 65 will rise from 13 to 20% of the United States population. Some major concerns regarding older people include malnutrition and unintentional weight loss. There are various factors that play a role in the development of these problems in older people but decrease in taste potency is a major contributor. In order to improve the care and quality of life available to elderly patients, caretakers must be familiar with factors that contribute to taste loss.

Taste loss in elderly patients is mostly attributed to the loss of taste sensation as opposed to physical pressure. Taste recognition thresholds and tongue pressure point differentiability of elderly versus young adults were evaluated by researchers from the Tokyo Medical and Dental University in Japan. Basic taste sensation thresholds were tested via administration of litmus paper and the results suggested that age significantly increased the concentration needed for subjects to recognize the flavor. However, the data collected from the two point differentiability test suggested that there was not a significant difference between the elderly and young adults regarding the ability to distinguish points of sensation on the tongue. This shows that elderly people are able to adequately feel pressure on the tongue, but the taste receptors are not as sensitive as younger people.

Since poor taste bud function is the main culprit for decreased taste acuity, research must be conducted to discover the etiology of this lack of sensation. Various hypotheses have been suggested including anosmia (smell loss), zinc deficiency, poor oral care, inflammation and increased medication usage.

The primary objective of this review is to discuss a collection of studies that have been conducted by researchers to evaluate possible causes of decreased taste acuity of elderly persons using peer reviewed research articles. This review found mixed results regarding the effect of smell loss, although evidence does suggest that, zinc deficiency, poor oral care, inflammation, and medication use all likely contribute to taste loss.

METHODS

Using the Web of Science and EBSCO research databases, key words “elderly”, “taste loss” and “causes” were used to find primary research articles. The EBSCO database yielded 1721 results and Web of Science produced 36 that were then sorted based on relevance. Articles involving studies that addressed specific physiological causes of taste loss were chosen for this review. Ten articles were chosen and their methods, results and conclusions will be discussed. These articles focus on the direct effect of various factors on the actual functionality of taste buds although there are other mechanisms by which environment can change taste perception.

RESULTS/DISCUSSION

It is a common belief that smell and taste are related. Often, people attribute a distaste for
certain foods based off of the aroma produced. It is important, though, to understand if lack of smell can cause a decrease in taste bud sensitivity or if the two merely often occur together. Via whole mouth taste identification tests, Hummel et al.\textsuperscript{3} evaluated the gustatory functioning of patients with and without anosmia. By comparing test scores of the anosmiacs and normosomniacs, the researchers observed that people with impaired olfaction also had a decreased sensitivity to sour, bitter, sweet, and salty stimuli. Conversely, Stinton et al.\textsuperscript{4}, through a similar study, used electrical and chemical measures to rate gustation ability. The olfactory test UPSIT, found that a lack of smell was not likely what caused taste loss since the whole mouth taste intensity scores and electrical thresholds of the subjects were not significantly related to their UPSIT scores. Stinton et al. attributes this difference to the lack of control observed in the formerly discussed experiment. Hummel et al. did not control for age and sex. Once these controls were put in place, Stinton et al. observed that smell loss likely does not cause taste loss, but further research is required.

Another possible cause of taste loss is zinc deficiency which is associated with increased age.\textsuperscript{13} Zinc is a micronutrient that is commonly found in foods derived from animal sources and deficiency is not common except in cases of malnutrition. Stewart-Knox et al.\textsuperscript{5} evaluated the relationship between zinc deficiency and taste loss. These researchers measured serum and erythrocyte zinc status and compared test results to subjects’ taste acuity, which was assessed by a flavor differentiation test. They concluded that zinc depletion is a contributor to decreased sensitivity. These results indicate that malnutrition of the elderly is a compounding cycle. Elderly patients who are malnourished may become zinc deficient, which contributes to taste loss and leads to anorexia and further malnutrition. Increased dietary zinc or supplementation may be warranted to intervene within this cycle.

Although it is evident that zinc deficiency contributes to taste loss, the mechanism remains to be discussed. Researchers at the Japanese Graduate School of Agricultural Science of Tohoku University compared the salt preference and carbonic anhydrase (CA) activity in salivary glands of rats fed diets that were either zinc-deficient (Zn-Def) or sufficient (Zn-Suf).\textsuperscript{6} After only 4-days, the rats that were part of the Zn-Def subgroup had a preference for increased salt levels-confirming that zinc deficiency can rapidly contribute to decreased taste sensitivity. Furthermore, these researchers confirmed that the Zn-Def rats had decreased activity of CA. CA is an enzyme which is necessary for the production of the protein gustin in salivary glands which participates in taste bud upkeep. Since CA contains zinc, it makes sense that a deficiency of zinc would cause taste buds to not function optimally.

Along with reduced nutrient intake, increased age is associated with incidence of dental caries, mucosal inflammation, plaque, and overall poor oral hygiene.\textsuperscript{14} Solemdal et al.\textsuperscript{7} compared the dental conditions-to taste acuity in 174 mentally aware but hospitalized elderly patients. The researchers specifically looked at a mucosal inflammation score (MS), mucosal-plaque score (MPS), and amount of bacterial growth in the mouth by administered taste strips. Patients with higher levels of inflammation, plaque, caries, and bacteria also had a lower level of taste sensitivity. Specifically, the ability to taste sour was compromised. Researchers attributed this phenomenon to bacterial acid production. Increased acid in the mouth causes physiological adaption of the sour-sensing taste buds to respond to stimuli at a higher threshold. These results call attention to the need for proper oral care as a person ages. Dental caries and plaque can be prevented by regular tooth brushing, tongue brushing, and flossing. Caretakers of elderly people may need to be aware of the implications of having poor oral hygiene and incorporate a regular
habit of oral cleaning into the life of the person whom they care for in order to prevent taste loss and malnutrition.

As a person ages, the effects of chronic inflammatory diseases become increasingly manifested with progression of the disease. Many inflammatory cytokines such as interferons and tumor necrosis factor (TNF), have a greater effect on taste buds than on other cells in the body and are likely to initiate taste bud cell death.\(^8\)\(^{15}\) Cohn et al. tested the effect of injected lipopolysaccharides (LPS)- a natural product during inflammation - on taste bud cell turnover in rats. This was done to elucidate the role LPS stimulation may play in taste loss by increasing cytokines. Rats that were treated with the LPS showed an increased expression of TNF, interferons, and interleukin-6. The researchers also labeled the tongue cells of both the control and treatment group to evaluate taste bud cell turnover. The number of labeled cells that entered taste buds during a period of 30 days was used to indicate whether taste buds were able to renew themselves. The LPS treated rats had a lower concentration of labeled cells enter the taste buds which indicates lower rates of renewal. The turnover rate was ten days as compared to the control group’s 12 day turnover. These results demonstrate that inflammation caused taste sensation to decrease due to accelerated taste cell death combined with a decreased capacity for those cells to renew themselves. These results are supported by Wang\(^9\) who found that taste bud cells were more susceptible to these inflammatory markers due to their location at the exterior of the pores of the tongue. Testing showed that inflammatory cytokines will alter gene expression and cause cells to undergo apoptosis quicker. These results indicate further need for controlling inflammation in elderly patients. Preventative care should be taken to decrease the progression of chronic diseases through treatment such as lifestyle and diet modification.

With the increase in chronic disease and decrease in wellbeing, the elderly are often prescribed more medications that may have side effects and/or interact with each other. McLaughlin\(^10\) conducted an observational study which showed that 93% of subjects that had survived head and neck cancer with therapy had a considerable level of taste loss. Epstein\(^11\) et al. saw similar results in a study that demonstrated a statistically significant correlation between taste loss and those who had been treated with chemotherapy. Chemotherapy targets cells that have a high turnover rate and kills tumors that quickly proliferate, but it is not cancer cell specific. These chemicals will also kill benign cells of the body that quickly turnover such as taste buds.

Schiffman et al.\(^12\) evaluated a wide variety of drugs that they suspected could have an effect on taste acuity. Taste thresholds were measured in those taking 62 different drugs and compared to a control via a taste threshold test. All 62 drugs demonstrated some effect on taste, but several drugs commonly used for the elderly notably decreased sensitivity. These included Elavil (antidepressant), Ampicillin (antibiotic), Cyclobenzprine (muscle relaxant), Nabumetone (nonsteroidal anti-inflammatory for rheumatoid arthritis and osteoarthritis), and Mexiletine (antiarrhythmic). The side effects of drugs can be very complex, and even if they are the sole drug being used in a combination with other medications, they can alter taste sensations in a variety of ways as demonstrated by the results of this study. Healthcare providers should be aware of possible drugs side effects and care for their patients accordingly.

In closing, the need to understand the process of aging and how to care for elderly people is becoming increasingly critical in our aging world. Taste loss is a major contributor to elderly malnutrition and must be understood so that proper treatment and care can be implemented. Some of the major contributors to taste loss include zinc deficiency, poor oral care,
inflammation, and medication use. These factors must be controlled by healthcare personnel and family in order to provide superior care for the elderly and prevent the development and progression of malnutrition.