Sensory stimulation of taste and smell in older adults: a literature review
Estimulação sensorial do paladar e do olfato em idosos: uma revisão de literatura

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ABSTRACT

The sensory stimulation of smell and taste are very important. Now is the time to pay more attention to it, since its correct functionality is essential for life, health and safety of people, especially in old age. At this stage, is when these senses are deteriorating, possibly due to decreased production of receptor cells. Therefore, the objective of this article is to identify existing methods for sensory stimulation, physiology and evaluation of the chemo—sensory senses: taste, smell and everything that contributes to the knowledge, approach and intervention of these senses. Documentary design was applied, with reference review in databases such as: MEDLINE, LILACS, SciELO, Springer, Elsevier, EBSCO and Google Scholar. Descriptors in Health Sciences (DeCS) were used: Aged, Taste perception, Sense of Smell, Sensation. The search included the languages: English, Portuguese and Spanish. The references have been published in the last 6 years. That is, from 2017 to 2022. 30 articles were included since they met the inclusion and exclusion criteria. The results obtained were: identification of physiology, evaluation methods, diagnosis, and stimulation. They have been implemented and have been shown to be suitable for exploring, analyzing and improving functionality. In conclusion, diagnostic tests and sensory stimulation methods are suitable for application in elderly people.

Keywords: Older adult. Taste. Smell. Sensory function.

RESUMO


Palavras-chave: idoso; técnicas de exercício e de movimento; velocidade de caminhada; terapia por exercício.

RESUMEN

La estimulación sensorial del olfato y el gusto son muy importantes. Y ahora es el momento de prestarles más atención, ya que su correcto funcionamiento es fundamental para la vida, la salud y la seguridad de las personas, especialmente en la vejez. Es entonces cuando estos sentidos se deterioran, posiblemente debido a una disminución en la producción de células receptoras. Por tanto, el objetivo de este artículo es identificar los métodos existentes de estimulación sensorial, fisiología y evaluación de los sentidos quimiosensoriales: gosto, olfato y todo lo que contribuye al conocimiento, abordaje e intervención de estos sentidos. Con la aplicación de diseño documental, con revisión de bibliografías, en bases de datos como: MEDLINE, LILACS, SciELO, Springer, Elsevier, EBSCO y Google Scholar, utilizando Descriptores en Ciencias de la Salud (DeCS): Envejecimiento, Percepción del Gasto, Senso del Olfacto, Sensación. Se utilizaron los Descriptores en Ciencias de la Salud (DeCS): Adulto Mayor, Percepción del Gasto, Olfato, Sensación. La búsqueda incluyó los siguientes idiomas: inglés, portugués y español. Se publicaron referencias en los últimos 6 años. Es decir, del 2017 al 2022 se incluyeron 30 artículos que cumplieron con los criterios de inclusión y exclusión. Los resultados obtenidos fueron: identificación de la fisiología, métodos de evaluación, diagnóstico y estimulación. Se implementaron y demostraron ser adecuados para explorar, analizar y mejorar la funcionalidad. En conclusión, las pruebas diagnósticas y los métodos de estimulación sensorial son adecuados para su aplicación en personas mayores.

Palabras clave: ancianos, ejercitar técnicas de movimiento; la velocidad al caminar; terapia por ejercicio.
INTRODUCTION

Over the years, the ability to perceive through the chemical senses (taste and smell) decrease. That means that there is deterioration with aging, especially after the age of 60 (Bigman, 2020). These changes are probably attributed to the reduction and/or dysfunction in the renewal of receptor cells (Högerle, 2019) (Sergi et al., 2017). Regarding olfactory impairment or decrease in older adults, when it occurs gradually, it has been called presbyosmia. With this concept used appropriately, it would help to establish differences among disorders. It usually occurs in neurodegenerative diseases (Delgado et al., 2020). Regarding taste, the investigations carried out show dysfunction in basic flavors. Sensitivity to acid or sour and bitter is the most affected (Delgado et al., 2020).

The different disorders are detailed in Table 1. We found the particularity that in taste, most of the dysfunctions are mainly attributed to the failure of the olfactory sense (Obiefuna & Donohoe, 2022) (Doty, 2019). In the prevalence of these disorders, unanimity has not been found This is because in each country and population there are different data, due to the diversity of tests applied. However, it was found that there is a higher prevalence of affection in older people than in young people. And more in men than in women (Doty, 2019a). Here is the justification for the implementation of sensory stimulation of taste and smell in older adults. It seeks thereby the preservation of their functions.

Table 1 Classification of senses disorders: taste and smell

<table>
<thead>
<tr>
<th>DISORDERS</th>
<th>SMELL</th>
<th>TASTE</th>
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<tbody>
<tr>
<td>Quantitative</td>
<td>Hyperosmia (increased sense of smell)</td>
<td>Hypergeusia (increased sense of taste)</td>
</tr>
<tr>
<td></td>
<td>Normosmia (normal olfaction)</td>
<td>Normogeusia (normal taste)</td>
</tr>
<tr>
<td></td>
<td>Hyposmia (Decreased sense of smell)</td>
<td>Hypogeusia (decreased taste ability)</td>
</tr>
<tr>
<td>Anosmia</td>
<td>Functional (Low residual capacity in everyday life)</td>
<td>Ageusia (Complete loss of taste)</td>
</tr>
<tr>
<td></td>
<td>Complete (No detectable residual odor)</td>
<td>Parageusia (altered perception of flavors before a stimulus)</td>
</tr>
<tr>
<td>Qualitative</td>
<td>Parosmia (altered perception of odors in response to a stimulus)</td>
<td>Phantogeusia (Impression of taste in the absence of stimulus)</td>
</tr>
<tr>
<td></td>
<td>Phantosmia (Perception of odors in the absence of a stimulus)</td>
<td>Olfactory intolerance (excessive or reduced subjective sensitivity)</td>
</tr>
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</table>

Source: (Högerle, 2019)

In elders, changes of aging are aggravated by the use of medications, dentures, etc., due to the decrease in mucin and calcium. These influence the decrease in saliva, increasing the ionic concentration (Rupel et al., 2021) and affect both the oral coating and the perception of flavors (Sergi et al., 2017). All these aspects, in the long run, influence the sensory and textural perception of food, leading to a decrease in its intake and therefore to poor nutrition. (Xu et al., 2019).

The nutritional status of the PAM is related to the senses of taste and smell. They are very important when choosing the food to eat. For this reason, they require considerable attention (Kershaw & Mattes, 2018). Depending on the type of food that people eat, is the proportion of vitamins (thiamine, Vitamin D, Vitamin C, folic acid, etc.), minerals (iron, Zinc, phosphorus, etc.) and other components that benefit or harm nutrition. This could lead to a deficit or excess, ending up in nutritional disorders (Jeon et al., 2021).

These aspects of the senses of smell and taste have often been left aside and overlooked. Hence the importance, innovation, relevance of the evaluation of these senses. The application of sensory stimulation strategies aims at preserving or improving functionality. It will also help the intake of food, which contribute to an optimal nutritional status of the PAM. With the application of sensory stimulation of taste and smell, maintaining or improving their functionality is sought.

THEORETICAL FOUNDATION

Background review

Velasco J, in his doctoral thesis in Alicante in 2018, with the title “Program for sensory stimulation of taste and smell for Alzheimer’s patients: GYMSEN Project”, carried out a program dating back to 2013, in order to stimulate the senses of smell and taste. It also aim at recovering interest in food and maintaining sensory capacities in older adults from three different groups. 1. People over 55 years of age without sensory impairment, 2. People who regularly attended university classrooms of Experience, at Miguel Hernández University; 3. Institutionalized people from the Italian NGO dedicated to social management and projects focused on the elderly. And Alzheimer’s patients from the Greek non-profit
organization Athens Association of Patients with Alzheimer and Related Disorders. They used both qualitative and quantitative methodology, with the application of the sensory training program. It lasted 3 months. The activities were organized in 24 sessions (twice a week for 12 weeks) The duration of each session varied between 1 and 1.5 hours. Finally, they concluded that the program is beneficial, focusing on two fundamental aspects: improvement in sensory function and therefore in nutritional status (Velasco Navarro Juan Francisco & Collado Enrique Roche, 2017).

Guarnéros M et. al, carried out his review article in Mexico in 2020, “Smell Alterations in Obesity”. Its objective was to relate the perception of food with obesity, since there has been little investigated on the topic. It included review and reading methodology of 100 scientifically-based articles: Pub med, Scielo, Redalyc and Science direct. It concluded that the current evidence indicates that the sense of smell is altered in obese population. And that it is necessary to do research on whether it is a general decrease, as indicated in some studies, or if perception is increased for some stimuli (eg, stimuli of high caloric value) and decreased for others (eg, stimuli not associated with food) (Guarnéros et al., 2020).

Pugnaloni S. et al., in 2020 with their article “Modifications of taste sensitivity in cancer patients: a method for the evaluations of dysgeusia”, had the objective to analyze taste alterations in the patient population. It compared with healthy controls and considered the gender. It sought to prevent and/or reduce taste disturbances and malnutrition in people with cancer. Forty-five cancer patients undergoing chemotherapy intervened and were compared with thirty-two healthy controls. They used the taste function test to determine the taste sensitivity with different concentrations, including the four basic tastes (salty, sweet, sour, bitter) They included fat and water. They concluded that coping strategies should be provided in the face of subjective taste impairment. Alterations in taste sensitivity influence food preferences and appetite. Therefore, clinicians could have the potential to support changes in dietary intake. And, consequently, in the nutritional status of patients by adopting appropriate appetiteing strategies and, based on this, modifying their eating habits (Pugnaloni et al., 2020).

Higgins M. and Hayes J. in their research carried out in Pennsylvania in 2019, “Regional variation of bitter taste and aftertaste in humans”, had the objective to explore regional differences in the perceived intensity of bitter stimuli in the regions of the oral cavity in 2 experiments. In the first experiment they used a whole mouth slurp and spit procedure and in the second experiment a spatial taste test using cotton swabs. Data collection was done at the Penn State Sensory Evaluation Center, in semi-insulated test booths. After the research, they concluded that bitter stimuli vary in perceived intensity at various locations in the oral cavity through the observation of intensity differences in both a spatial taste test and a slurp and spit protocol. Bitter stimuli also differ in terms of temporal perception, as some stimuli tend to linger while others decay much more rapidly after reaching the same maximum intensity. (Higgins & Hayes, 2019).

Hurtado K. in his Thesis carried out in 2020 Alicante, “The flavors of food and nutrition in elderly people. Gender analysis”, had the purpose to analyze the scientific evidence available on the differences according to sex and gender in the taste and smell of food in older adults. These should be taken into consideration to offer adequate nutritional care. It took place through the reference review of original articles in the MedLine database in the last 10 years. Languages: Spanish and English. Search keywords: “Taste and sex-differences”, “Elderly and taste disorders and sex differences”, with the inclusion criteria: articles that analyzed taste in the elderly, by gender and type of neurodegenerative disease. After the scientific review, he concluded that there are differences according to sex in the elderly population where men have a lower perception of taste. On the other hand, women presented more olfactory alterations and consequently taste alterations. This situation worsened with neurodegenerative diseases and affected the nutritional status of the elderly. In most of the studies, the gender perspective was not included in the taste analysis. Taking this into account, better nutritional care and prevention could be offered to healthy and sick elderly people (Hurtado Soria Karen Alejandra & Ruiz Cantero María Teresa, 2020).

Kershaw J. and Mattes R, in their review article carried out in the United States, in 2018, “Nutrition and taste and smell dysfunction”, searched for scientific articles, in scientific bases: Pub med, Scielo, Redalyc, Science direct, with the objective of verifying if sensory stimulation influences the selection and metabolism of food. Their study used a review methodology and scientific reading of 130 articles. They concluded that taste and smell play an important role in the selection of diet and metabolism, taking into account culture, environment and exposure (Kershaw & Mattes, 2018).

Alia S et al., in 2021 in the article “The influence of age and oral health on taste perception in older adults: A case-control study”, established the objective of investigating the effect of age and oral condition on discrimination of taste in two different groups of elderly subjects living in an Italian residential institution or in the community. A total of 90 subjects were enrolled in the study. They performed the evaluation using the two-color mixability test. Taste function was assessed using cotton pads soaked with six taste stimuli (salty, sour, sweet, bitter, oily, and water). They concluded with a positive correlation between age and teeth and a negative correlation between age and masticatory mode. In addition, they determined significant differences in the sensitivity to bitter taste between subjects who used removable and non-removable prostheses. Significant gender differences and between males were identified in the two samples (Alia et al., 2021).

Melis M. et al., in 2019 carried out the investigation and publication of the article “TAS2R38 bitter taste receptor
and attainment of exceptional longevity”, with the aim of evaluating the role of the bitter receptor TAS2R38 in the achievement of longevity. It has been widely associated with individual differences in taste perception, food preferences, diet, nutrition, immune responses, and pathophysiological mechanisms. It also focused on determining differences in genotype distribution and haplotype frequency in the TAS2R38 gene among a cohort of centenarians and near centenarians and two control cohorts. They concluded, based on their data that provide evidence for an association between genetic variants of the TAS2R38 gene and human longevity, that the TAS2R38 bitter receptor may be involved in the molecular physiological mechanisms involved in the biological process of aging. It suggests that individuals who have a pair of functional alleles (PAV/PAV) in the TAS2R38 gene may have a favorable genetic condition to achieve exceptional longevity (Melis et al., 2019).

Delgado M. et al, in the year 2020, the article, “Spanish validation for olfactory function testing using the sniffin’ sticks olfactory test: Threshold, discrimination, and identification”, was carried out to validate the test in a Spanish sample. This study included 209 healthy normosmic male and female volunteers, ranging in age from 20 to 79 years. Of this group, 22 participants were retested for evidence of test-retest reliability. Odor familiarity for descriptors in the olfactory identification test was also studied in an independent healthy sample. Required cultural modifications were applied. The full version of the Sniffin’ Sticks Olfactory Test (TDI) was administered to an initial group of 242 participants aged between 18 and 79 years. These participants came from social networks, advertisements in public places (such as universities, libraries and contact with private companies) and from the Central Hospital of the Red Cross (Madrid, Spain). The evaluations were carried out between July 2020 and September 2020. The results were that men and women, as well as smokers and non-smokers, performed equally in all the tests. However, significant differences were found between the age groups in each score. The general trend is that the olfactory function progressively decreases with age, with the elderly group (+60 years) showing the lowest scores. In conclusion, these normative data, in addition to the cultural modifications of the test, make it possible to apply the Sniffin’ Sticks Olfactory Test in the Spanish population (Delgado-Losada et al., 2020).

Oleszkiewicz a. et al., in their article carried out in Europe in 2018, “Updated Sniffin’ Sticks normative data based on an extended sample of 9139 subjects”, had the objective to provide updated and detailed normative data based on a large-scale sample. It helped increase diagnostic validity by reference to narrow age groups, as previous normative values were based on smaller sample sizes, especially in the older group of subjects. They obtained data from 9139 healthy subjects (4928 women of 5-96 years and 4211 men of 5-91 years old), to whom they applied the standard “Sniffin’ Sticks” test. It includes the threshold (T), discrimination (D) and identification (I) subtests, which yields a total TDI score. For the interpretation of results, hyposmia with a TDI score below 30.75 was established. They observed age-related changes in each area, higher in the case of thresholds. Individuals between 20 and 30 years of age obtained the best results, while

Delgado M- et al., in 2021 in Spain, carried out the article “Development of the Spanish version of sniffin’ sticks olfactory identification test: Normative data and validity of parallel measures children under 10 years of age and adults over 71 years of age obtained only half the score. They reached the conclusions, based on data provided, that there is guidance to assess individual olfactory performance in relation to specific age groups. There are significant effects of gender and age, with a higher increase in olfactory test scores between 5 and 20 years of age and a drastic decline between the ages of 60 and 71 (Oleszkiewicz et al., 2019). “, with the aim of developing the Spanish version of the Sniffin’ Sticks Olfactory Identification Test and of obtaining normative values for the Spanish population, with free parameters. They conclude that there is subjective intensity of the odorants. The influence of possible demographic covariates such as sex, age, smoking or educational level are analyzed, and the items that best discriminate are studied. Additionally, they perform a cultural adaptation of the violet version. For this, three independent samples of normosmic healthy volunteers were studied with the objective of obtaining normative values. The sample was 417 participants (18-89 years old) (Delgado-Losada et al., 2021).

METHODS

A descriptive review article was carried out. It included the application of documentary design and review of references in databases such as: MEDLINE, Redalyc, LILACS, ScIELO, Springer, Elsevier, EBSCO and Google Scholar. Descriptors in Health Sciences (DeCS ): Aged, Taste perception, Sense of Smell, Sensation were used. These were included in the languages: English, Portuguese and Spanish. They were published in the last 6 years, that is, from 2017 to 2022, 30 articles were reviewed because they met the inclusion and exclusion criteria (Figure 1). This process was carried out in order to collect and analyze data on the senses of taste, smell, functionality, tests for their evaluation and existing sensory stimulation methods

Table 2 Scientific articles selected for review

<table>
<thead>
<tr>
<th>Authors</th>
<th>Country</th>
<th>Type</th>
<th>Title of article</th>
<th>General Objective</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baghmati Gajeya (2020)</td>
<td>EE. UU</td>
<td>Original</td>
<td>Age-related Smell and Taste Impairments and Vitamin D Associations in the U.S. Adults National Health and Nutrition Examination Survey.</td>
<td>To examine the associations between vitamin D (VDS) deficiency and smell and taste disturbances in adults aged 40 to 80 years.</td>
<td>The study showed that Vitamin D probably plays an important role in the senses of smell and taste, due to the discovery of the significant association it has with existing deficiency in people over 70 to 80 years of age. Out of the participants in their study, approximately 20%, presented vitamin D deficiency.</td>
</tr>
<tr>
<td>Delgado et al. (2020)</td>
<td>Spain</td>
<td>Review</td>
<td>Analysis of alterations in the senses of taste and smell in older adults: a review of the literature.</td>
<td>To update the existing knowledge about the alterations of the taste and smell senses, during aging.</td>
<td>After reviewing 13 articles, they conclude that both taste and smell decrease with age, especially after 65 years of age. This may be due to reduced renewal of taste and smell receptors, or also by pharmacological treatments derived from chronic or acute diseases that can occur with age.</td>
</tr>
<tr>
<td>Turner J. H. (2020)</td>
<td>Germany</td>
<td>Review</td>
<td>Olfactory training: what is the evidence?</td>
<td>Incorporate a fundamental treatment for olfactory disorders both in clinics specialized in smell and taste and in general otolaryngology practices.</td>
<td>Data suggest that olfactory training could potentially improve olfactory function. And that if there is a combination of interventions it may be superior, as suggested by a small number of studies that combine olfactory training with systemic or topical corticosteroids.</td>
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<td>Hogeirle (2019)</td>
<td>Germany</td>
<td>Review</td>
<td>Electrosensory diagnosis and testing: a glimpse of the future?</td>
<td>To review the chemosensory functions of smell, taste and the disorders, with the consequences, that they bring in old age.</td>
<td>In old age, the decrease in chemosensory senses could lead to weight gain or loss, social isolation, depression; even dangerous situations could arise due to the dysfunction.</td>
</tr>
<tr>
<td>Knehay y Mattes (2018)</td>
<td>USA</td>
<td>Review</td>
<td>Nutrition and taste and smell dysfunction.</td>
<td>To discuss how sensory stimulation influences food selection and metabolism; And how to relate these aspects to the dysfunction of smell and taste.</td>
<td>The sensory ability of taste and smell do play an important role in the selection of diet and metabolism. However, the context of other factors, such as environment, exposure, and culture must be considered.</td>
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<tr>
<td>Viren et al. (2021)</td>
<td>Italy</td>
<td>Review</td>
<td>Taste sensitivity in healthy adults: gustatory test validation and observational study.</td>
<td>To establish a diagnostic and standardized tool, available for use in clinical practice and evaluation of healthy adults.</td>
<td>Considering the identification threshold and flavor intensity, they apply the test to 72 participants, with whom the test itself was validated. They used the four main flavors with four different concentrations, for their identification.</td>
</tr>
<tr>
<td>Cataneo et al. (2021)</td>
<td>Italy</td>
<td>Original</td>
<td>Differences in taste and smell perception between type 2 diabetes mellitus patients and healthy controls.</td>
<td>To evaluate the perception of taste and smell in patients with Diabetes Mellitus 2 (DM2) and healthy controls.</td>
<td>In the study, hypoguesia and hyposmia prevailed in the majority of DM2 participants, compared to healthy control participants. It suggests a possible neurodegenerative complication of diabetes.</td>
</tr>
<tr>
<td>Delgado et al. (2021)</td>
<td>Switzerland</td>
<td>Original</td>
<td>Development of the Spanish Version of Sniffin’ Sticks® Olfactory Identification Test and obtain normative values for the Spanish population. Also to validate the internal structure of the blue and purple versions as a parallel measure, carrying out a cultural adaptation, (translated to the purple version).</td>
<td>To develop the Spanish version of the Sniffing Sticks® Olfactory Identification Test and obtain normative values for the Spanish population. Also to validate the internal structure of the blue and purple versions as a parallel measure.</td>
<td>They found differences in the results as age increases, especially from 60 years of age. They concluded that Test-sniffing sticks is the appropriate tool for olfactory evaluation, providing the extraction of seven items with which it could be used as an abbreviated test in the blue version. They provide additional evidence of validity of the internal structure of the 2 versions. (Blue and purple).</td>
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<tr>
<td>Huang et al. (2021)</td>
<td>China</td>
<td>Original</td>
<td>Reliability of whole-mouth taste test in assessment of gustatory function in healthy adults.</td>
<td>To assess the test-retest reliability of taste function using whole-mouth taste tests in healthy adults.</td>
<td>With an ICC=0.7 they conclude that the whole-mouth test is a reliable method for subjective taste function since it has good test-retest reliability in the evaluation of subjective taste function in healthy adults.</td>
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<td>Solte et al. (2021)</td>
<td>Norway</td>
<td>Original</td>
<td>Small taste and trigeminal disorders in a 65-year-old population.</td>
<td>To investigate the prevalence of disorders of smell; taste, trigeminal nerve and associated factors in the 65-year-old population in Oslo, Norway.</td>
<td>Revelation that out of the 65-year-old population, a third have altered mouth test is a reliable method for subjective taste test in healthy adults.</td>
</tr>
<tr>
<td>Guaneros et al. (2020)</td>
<td>Mexico</td>
<td>Review</td>
<td>Small disorders in obesity</td>
<td>To review the literature on the relationship between the sense of smell and obesity.</td>
<td>Based on current evidence, it indicates that the sense of smell is impaired in the obese population. They point out that further research should be conducted as this is a promising area for further study.</td>
</tr>
<tr>
<td>Balungwe et al. (2020)</td>
<td>Africa</td>
<td>Original</td>
<td>Adaptation of the Sniffing Sticks test in South-Kivu</td>
<td>To evaluate the applicability of the Sniffing Sticks test in the population of South-Kivu (DR Congo), and the culturally adapted version of the Sniffing Sticks test for the South Kivu population was established with changes in 5 odors due to having shown difficulty in recognizing them.</td>
<td>The identification test they also conclude</td>
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</tbody>
</table>
The act of perceiving taste is called taste and the act of perceiving odors is called olfaction. The taste capacity is closely linked to the olfactory capacity. In cases of dysfunction it is believed that most presentations of taste dysfunction are due to smell damage (Obiefun & Donohoe, 2022) (Nørgaard & Fjælledstad, 2021).

**RESULTS AND DISCUSSION**

**Sensory stimulation of taste and smell in older adults: a literature review**

Develop a culturally adapted version with normative values.

There was no significant impact of age on identification.

Barragan et al. (2018) Spain Original Bitter, Sweet, Sour, Salty, and Umami Taste Perception Decreases with Age: Sex-Specific Analysis. Modulation by Genetic Variants and Taste Preference Associations in 18 to 80 Year-Old Subjects. To study the influence of age on the assessment of the intensity of the five basic flavors: sweet, salty, bitter, sour, and umami (separately and together in a “total taste score”) and its modulation by sex and genetics in a relatively healthy population (men and women) aged 18 to 80 years. They found a great variety of perception of the 5 basic flavors. They confirmed that as age advances, there is a decrease in taste perception, mainly in bitter and acid flavors. They also detected differences in taste dysfunctions according to sex, with the male sex being more affected.

Huang et al. (2020) China Original Normative data on the subjective gustatory function of Chinese adults. To evaluate the gustatory functions of healthy Chinese adults with the whole-mouth test based on five basic tastes, including umami taste. They obtained a significant negative correlation with age, according to the trend score of taste recognition because the age group from 51 to 65 years presented the lowest scores and they also suggested that the full mouth test is simple, reliable, and quick application.

Nørgaard et al. (2021) Denmark Original Differences in Correlation between Subjective and Measured Olfactory and Gustatory Dysfunctions after Initial Ear, Nose and Throat Evaluation To assess the taste function of healthy Chinese adults with the whole-mouth test based on five basic tastes, including umami taste. The taste function is poorly related to the measurable. Thus it also reflects olfactory dysfunction. While on the contrary the subjective olfactory dysfunction was positively correlated with the measurable. Out of the 602 research participants 50% showed normal taste functions and subjective alterations of the smell. 98% classified their measurable olfactory function as absent; plus only 64% were anosmic. Therefore, it is advisable to carry out validated chemo-sensory tests, since they could help to guarantee more accurate diagnoses and timely treatment.

Doty & Potter (2021) USA Original Validation of the Waterless Empirical Taste Test (WETT®) To describe and validate the new Waterless Empirical Taste Test (WETT®) within a clinical population. It is portable and does not require liquid flavorings or liquid rinses. They demonstrated that the Waterless Empirical Taste Test (WETT®) can be as reliable and sensitive as it exhibited comparable sensitivity. Even in some cases it was higher than two comparison taste tests; whole mouth taste test and the most traditional flavor quotient taste test that are liquid based.

Von et al. (2019) Germany Original Impact of taste and smell training on taste disorders during chemotherapy – TASTE trial To improve taste disorders through taste and smell training. Out of the operated patients, taste improved significantly, from baseline (median taste strips: 7.0 points) to week 12 (median taste strips: 10.0 points). The group without intervention who completed the reassessment did not show changes. Therefore, they conclude that intermittent nutritional counseling with taste and smell training can improve taste perception in patients receiving chemotherapy.

Fjælledstad et al. (2018) Denmark Original The Test Reliability of Gustatory Testing Tools: Introduction of the Sensitive Taste-Drop-Test To introduce a sensitive taste-drop test, which uses a simple gradual increase in concentration, and compare the reliability of the repeat test of Taste-Strips taste-drop test. The Sensitive-Taste-Drop Test had a higher reliability for the five flavors: sweet, salt, sour and bitter. It had a greater internal consistency (Alpha of Cronbach: Sweet, 0.89; Salty, 0.83; Sour, 0.81; Bitter, 0.85).

Penzon R. (2020) Venezuela Original To propose a taste test adapted to the Venezuelan population. To develop a culturally adapted version with normative values. Both rehabilitation modalities were effective in our study. However, multisensory rehabilitation is a more effective tool in the treatment of patients with olfactory disorders.

Besse (2020) Germany Original Flavor education and training in olfactory dysfunction a pilot study. To implement flavor education (FE) in people with olfactory dysfunction (OD) and encourage these patients to experience flavors in terms of a flavor training (FT).

Doty (2019) USA Review Treatments for disorders of smell and taste: a critical review. To explore numerous investigations and their details described in the literature to treat and handle taste and smell disorders with primary focus on findings supported by critical, empirical evidence. Evidence for the efficacy of more than two dozen putative treatments for taste and smell disorders was reviewed. Among the most publicized treatments are “olfactory training”, phencyclidine, vitamin A, vitamin B12, and zinc sulfate.

Pedrazza & Linano (2021) Peru Review Taste disturbance as an indicator of systemic disease. To update existing theories about the physiology of taste, early and timely detection of different systemic or metabolic diseases such as diabetes mellitus, hypertension, and Covid-19. Taste disorders are an indicator in diseases such as type 1 diabetes mellitus, arterial hypertension, Alzheimer’s disease, cancer, among others. They demonstrate that there is a psychological impact on those who suffer from it. This affects their quality of life at the level of their tongues, Receptors that detect sweet, sour, bitter and umami flavors are studied, but even these data are limited.

Jeon et al. (2021) Korea Original Taste Sensitivity of Elderly People: Is Associated with Quality of Life and Inadequate Dietary Intake. To investigate the types of taste disturbances in Korean elders and the factors associated with the taste disturbance in relation to dietary intake and other factors. We performed correlation and regression analyses. The findings suggest that taste disturbances are related to low levels of four flavors where the exception was bitter taste.

Andrade et al. (2021) Mexico Review Smell and taste disorders, from the basis to the clinical practice. To choose healthcare personnel the way and importance of exploring the senses of smell and taste in treatment and rehabilitation options. The way of approaching smell and taste disorders was shown. It included the importance of the prevalence of these disorders and their impact as a prognostic factor in various diseases. The knowledge, practical and application of evaluation strategies should be medically mastered.

Delgado et al. (2020) Spain Review Spanish Validation for Olfactory Function Testing Using the Sniffin’ Sticks Olfactory Test: Threshold, Discrimination, and Identification. To validate the Sniffin Sticks test in a Spanish sample. They validated the familiarity with the smell of the descriptors in the Sniffin Sticks olfactory identification test and applied the required cultural modifications, with the respective test-retest. It found significant differences based on age.

Oleszkiewicz et al. (2019) Germany Original Updated Sniffin’ Sticks normative data based on an extended sample of 9199 subjects. To provide updated, detailed, and normative data according to the large-scale sample, in order to increase diagnostic validity by age groups, especially in the group of older people. The large sample has allowed groups of 10 years to be categorized. It obtained homogeneous results, which facilitated a detailed understanding of olfactory dysfunction in or various diseases. The knowledge, practical and application of evaluation strategies should be medically mastered.

Serp et al. (2017) English Review Taste Loss in the Elderly: Possible Implications for Dietary Habits. To analyze changes in taste perception related to age, and indications in food preferences. Agnosia can affect food preferences, although dietary habits appear to be more influenced by other factors such as social and psychological.

Bernadita et al. (2017) Chile Review Diagnoses in pathology of smell literature review. To establish available diagnostic tools in clinical practice for the study of smell. Tests such as UPSI (Smell identification test); in Sniff Stick test, have been established. They are of choice due to costs and ease of execution, despite the fact that they have limitations to apply to children and people with neurological or psychiatric disorders.

Delgado et al. (2021) Cuba Review Smell disorders. To update the clinical-therapeutic performance of disorders of the smell. Chemoreceptors function decreases with age. Aging thus affects the abilities of old people and impacts on their quality of life. Loss of smell lowers even more so in dementia and in some cases prevents the onset of cognitive deterioration.

Source: Authors based on retrieved literature
Physiology of the chemical senses: taste and smell

In the older adult population, a third have altered smell. More than a quarter present taste impairment. Dysfunction, in these two senses, is more common in women than in men (Sodal et al., 2021). On the other hand, the sense of taste indicates that men are more affected and mainly in the perception of bitter and acid flavors (Barragán et al., 2018) (Sergi et al., 2017a). In addition, in the case of taste, it can be used as an indicator in early and timely detection of diseases such as Type II Diabetes Mellitus, Arterial Hypertension, Alzheimer’s disease, Cancer, Covid-19, among others (Jeon et al., 2021). They have evidenced hypogeusia and hyposmia in Type II Diabetes Mellitus. This prevailed in the majority, which suggests that this may be due to a possible neurodegenerative complication (Catamo et al., 2021) (Delgado et al., 2021).

The use of drugs for the treatment of diseases, which appear as age advances and the decrease in the renewal of the receptor cells of the stimuli, are attributed to cause the appearance of alterations, in the senses of taste and smell, especially from the age of 65 (Delgado Olea et al., 2020) (Delgado-Losada et al., 2020). The decrease in these chemo-sensory senses can lead to: social isolation, depression or even deadly situations due to the non-perception of odors, flavors of damaged, toxic or flammable food such as household gas (Högerle, 2019). This can also cause nutritional disorders such as malnutrition and obesity. Obese population has shown impaired sense of smell (Guarneros et al., 2020).

Diagnosis and evaluation of taste and smell

Within the tests to carry out the diagnosis and evaluation of the chemo-sensory senses, we find a great variety of names with a similar procedure: Reliable taste test in subjective function and reliable in test-retest (Huang et al., 2021). It includes four primary flavors at four increasing concentrations in each flavor, with which the identification threshold and intensity are obtained (Veneri et al., 2021). It is evident that older adults have a recognition threshold, in higher concentrations than in young adults (Jeon et al., 2021) (Huang et al., 2021). Other types of existing reliable and sensitive tests that do not require flavoring liquids or rinsing are the Waterless Empirical Taste Test (WETT), which uses cellulose pads (Doty et al., 2015). Taste Drop Test showed, in all four flavors, an alpha Cronbach’s 0.88 sweet, 0.86 sour, 0.85 bitter, and 0.83 salty (Fjaeldstad et al., 2018). An adaptation of the taste test was found for the Venezuelan population, which was called easy, practical, reliable and safe. They carried it out with ten flavors (coconut, chocolate, peanut, grape, tail, coffee, tangerine, cinnamon, vanilla, and pineapple). These all flavors are substances known to the Venezuelan population (Pieruzzini 2020).

In the smell tests, several studies use similar tests. Among them we have sniffin sticks which consists of three components (threshold (T), discrimination (D), and identification (I)), with which the total score (TDI) is obtained (Balungwe et al., 2020) (Oleszkiewicz et al., 2019). It was originally created in Germany and validated with cultural adaptations in various countries, including the Spanish population (Delgado et al., 2021), in which normative data have been established. (Delgado-Losada et al., 2021)

Sensory stimulation as a treatment for smell and taste disorders.

The investigations suggest deepening in the implementation of sensory stimulation because it is a non-invasive and safe procedure. Thus, positive and statistically significant effects have been observed (Sorokowska et al., 2017). Some of them found a possible relationship with nutritional supplements, vitamins and minerals (Jeon et al., 2021). They show that by improving vitamin D deficiency, it could contribute to mitigating the chemosensory loss of smell, age-related taste among adults (Bigman, 2020) However, more evidence is required in experimental research on separate stimulation of smell and taste. Likewise, more studies on stimulation of the two senses that are closely linked in their functionality should be done (Turner 2020).

Smell training is suggested to be done from two to three times a day, for at least three months. It should include a representative in the fragrance categories: floral (rose), resinous (eucalyptus), fruity (lemon), spicy or aromatic (clove) (Fernández et al., 2021). They seem to improve olfactory disorders even in neurodegenerative diseases (Högerle 2019) (Doty, 2019). Another intervention for the training of taste and smell are: juices and foods of different flavors that should be tested blindfolded. This should be done for at least 15 min twice a week. The patients should smell the essence or aromatic species of lemon and cloves for 15 seconds two times a day, for 12 weeks, preferably in the morning and at night (Von et al. 2019).

Another form of intervention was: 50 favors of common ingredients, various spices, fruits and herbs. They were chosen according to ease and availability. During the training period, subjects were instructed to consciously experience all the flavors (“with all the senses”) from the list on separate days, especially those in which they were interested. Given a 16-week training period, time was provided to try a flavor from the 50 favor list every other day and complete a short questionnaire about each experience (Besser et al., 2020).

CONCLUSION
Stimulation strategies for smell and taste are, specifically, the daily exposure to smells and flavors, preferably twice a day. They can be in the morning and at night, in a period of 12 weeks. After this period of time, the functionality should be evaluated. Quantitative tests for “smell” type (Test Sniffing Sticks) and for “taste” type (taste Trops) will be used. By doing this, it will be possible to compare the functionality before and after the application of the strategies of stimulation of smell and taste.

REFERENCES


Contribution of each author to the manuscript:

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