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Correlation Between Gustatory Dysfunction, Olfactory Dysfucntion In Elderly Patients-A Cross Sectional Study

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Abstract:
Background: *Gustatory and olfactory dysfunctions are common in older adults, affecting quality of life, nutrition, and safety. These senses are crucial for relishing food and detecting hazards (like spoiled food or gas leaks), so impairment can lead to physical health risks. Emerging research suggests a link between sensory impairments and cognitive decline, including conditions like Alzheimer's disease and other dementias. Exploring these associations may provide insights into early biomarkers or predictors of cognitive impairment. Aims & Objectives: To determine the taste sensation and olfactory status in elderly patients. To correlate the results with cognition in elderly patients.*
Methodology: *A cross sectional study was conducted among 234 senior citizens (more than 60 years) came to OPD at Department of Otorhinolaryngology in our hospital during November 2024 to February 2025.*
Results: *In this study of 234 senior citizens (mean age 67.8 ± 5.9 years; 118 males, 116 females). Taste impairment was most common for sour (39.3%) and sweet (31.6%) flavors, while garlic (47.0%) and rose water (42.7%) were the most affected in olfactory assessment. Cognitive function, assessed using MMSE and MoCA, showed a stepwise decline, with participants having both GD and OD exhibiting significantly lower scores (MMSE: 23.9 ± 2.9, MoCA: 22.8 ± 3.1, p < 0.05) compared to those with either dysfunction alone.*
Conclusion: *The prevalence of GD (35.9%) and OD (58.5%) increased with age, and both were linked to lower MMSE and MoCA scores, confirming their potential role as early biomarkers for cognitiveimpairment. Multivariate analysis reinforced these findings, demonstrating that sensory impairment remains an independent predictor of cognitive deterioration, even after adjusting for comorbidities.*
Keywords: *Gustatory dysfunction, olfactory dysfunction, elder age group, outcome.*

INTRODUCTION

Gustatory and olfactory dysfunctions are common in older adults, affecting quality of life, nutrition, and safety. These senses are crucial for enjoying food and detecting hazards (like spoiled food or gas leaks), so impairment can lead to physical health risks. Emerging research suggests a link between sensory impairments and cognitive decline, including conditions like Alzheimer's disease and other dementias. Exploring these associations may provide insights into early biomarkers or predictors of cognitive impairment. Understanding these associations could lead to targeted interventions aimed at preserving sensory function or slowing cognitive decline in older adults. [1,2]

The senses of taste (gustation) and smell (olfaction) are part of the broader domain of chemosensation, which involves the detection of chemical stimuli in the environment. Olfaction occurs via specialized olfactory receptor neurons located in the nasal cavity, where odorant molecules interact with receptors to generate signals processed by the olfactory bulb and higher cortical regions. Gustation relies on taste receptor cells clustered within taste buds on the tongue and oral cavity, detecting five primary tastes: sweet, salty, sour, bitter, and umami. Together, these systems enable nuanced flavour perception, crucial for dietary preferences and nutrition.

Chemosensory functions play an integral role not only in hedonic experiences but also in vital health-protective behaviours, including food selection and the detection of environmental hazards. They work synergistically to contribute to flavour perception and nutritional intake, thus influencing overall health

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status and wellbeing. Aging-associated decline in these senses—often referred to as presbyosmia (for olfaction) and presbygeusia (for gustation)—can reduce appetite, increase risk of malnutrition, and impact social interactions around meals. [3,4]

While dysfunction in chemosensory abilities is commonly associated with elderly populations, questions remain regarding the independent effect of age on taste and smell. Differences in chemosensory abilities in elderly populations are often difficult to attribute solely to sensory function, as many age-associated factors such as overall health status, denture use, education, medication use, and other environmental insults can influence taste and smell responses. In studies that have observed differences, the effect varies widely among individuals and stimuli. Furthermore, the size of detected differences in the elderly may be clinically irrelevant in terms of influencing food choice or health status. [6,7]

This study could fill gaps in knowledge regarding how gustatory and olfactory impairments relate to cognitive changes, offering a foundation for early intervention strategies.

Aims & objectives: To determine the taste sensation and olfactory status in elderly patients. To correlate the results with cognition in elderly patients.

Methodology: A cross sectional study was conducted among 234 senior citizens (more than 60 years) age group patients came to OPD at Department of ENT in our hospital during November 2024 to February 2025.

Any patient who received oral steroids or immunomodulating medications in the past 30 days or a diagnosis of sarcoidosis, Wegner's granulomatosis, or other immunodeficiencies, and neurocognitive disorders including dementia, Alzheimers disease and Parkinson disease and Patients who underwent radiotherapy for oral cancers and diagnosed with atrophic rhinitis were excluded. Institutional ethics committee clearance was obtained and the number is SDUAHER/KLR/R&D/CEC/S/PG/125/2024-25. All patients satisfying the inclusion criteria was recruited in the study. Prior written informed consent of participation in the study was obtained. Patients satisfying the inclusion criteria was included in the study. The demographic data of the patients was collected.Oral cavity examination was done to rule out signs of vitamin deficiencies, presence of opportunistic infections like oral candidiasis. Taste assessment was done by both subjective and objective methods. Patients was instructed not to consume any food or drink half an hour prior to testing. Using a pipette, 3 drops of one taste solution was placed on the tongue starting from the lowest concentration. If the patient is able to identify the taste correctly once, it was taken as a positive result and a score was allotted. If the patient is unable to identify the taste, a solution of higher concentration was used. In this way score was allotted for different taste solutions depending on the concentration at which the patient is able to recognize the taste. After testing with each solution, the patient was asked to rinse his/her mouth to wash out any residual taste molecules prior to using the next solution. Scores was allotted for each taste class, the minimum score being 1 and maximum being 5 per taste class. Lower the score of the patient better the gustatory function. The minimum overall score a patient could get was 4 and, 20 the maximum. Four different Concentrations were used for each type of taste, bitter, Sweet, salty, and sour. (2)`

SWEET sucrose (gm/m)	SOUR citric acid (gm/ml)	SALTY sodium chloride (gm/ml)	BITTER quinine hydrochloride (gm/ml)	SCORE ALLOTED
0.4	0.3	0.25	0.006	5
0.2	0.165	0.1	0.0024	4
0.1	0.09	0.04	0.0009	3
0.05	0.05	0.025	0.0004	2
0.01	0.01	0.005	0.0001	1

Olfactory assessment was done by making the patients to identify the smell of naphthalene,rose water,garlic,clove oil and lemon. Mean scores were assessed for each subdomain of gustatory function and then all scores were summed into a final taste score .Impact of GD on mood, QOL, and social interaction was assessed through visual analog scales. Subjects completed the questionnaires MiniMental State Examination (MMSE), Montreal Cognitive Assessment (MoCA).Objective analysis was done basedon

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taste assessment protocol (annexure attached) and the results were analysed by appropriate statistical methods.

Analysis & Statistical methods

Data entry was done in Microsoft Excel sheet and analysed by using SPSS software version 26.qualitative data will be described as frequency and percentages and quantitative data will be described as Mean and SD. For analysing various variables chi square test, z test and Anova test will be used. Pvalue less than 0.05 will be considered statistical significant.

Results-

Table 1: Prevalence of Sensory Dysfunction

Type of Dysfunction	Number of Patients (n=234)	Percentage (%)
Gustatory Dysfunction (GD)	84	35.9%
Olfactory Dysfunction (OD)	137	58.5%
Both GD and OD	66	28.2%

Table 2: Cognitive Function Scores Based on Sensory Impairment

Sensory Status	MMSE Score (Mean ± SD)	MoCA Score (Mean ± SD)
No Dysfunction	27.3 ± 2.1	26.4 ± 2.7
GD Only	25.7 ± 2.5	24.9 ± 2.9
OD Only	24.8 ± 2.7	23.6 ± 3.2
Both GD and OD	23.9 ± 2.9	22.8 ± 3.1

Table 3: Correlation Between Sensory Dysfunction and Cognitive Decline

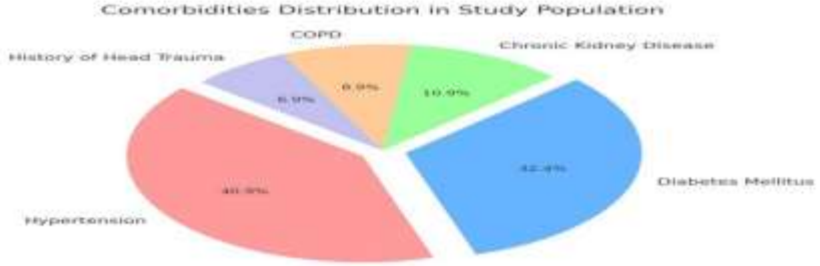
Variable	MMSE (r value)	p-value	MoCA (r value)	p-value
Gustatory Dysfunction	0.29	0.014	0.26	0.021
Olfactory Dysfunction	0.41	0.003	0.38	0.007

Table 4: Correlation Between Gustatory Dysfunction and Cognitive Function by Taste Modality

Taste Modality	MMSE (r value)	p-value	MoCA (r value)	p-value
Sweet	0.27	0.017	0.23	0.032
Sour	0.31	0.009	0.29	0.012
Salty	0.21	0.041	0.19	0.050
Bitter	0.19	0.058	0.17	0.064

In this cross-sectional study of 234 elderly participants (mean age 67.8 ±5.9 years; 118 males, 116 females), gustatory dysfunction (GD) was observed in 35.9%, olfactory dysfunction (OD) in 58.5%, and both in 28.2% of cases, with prevalence increasing significantly with age ($p < 0.05$). [Table 1]

The study population had a high prevalence of comorbidities, including hypertension (53.0%), type 2



diabetes mellitus (41.9%), chronic kidney disease (14.1%), and COPD (11.5%), with a mean BMI of 25.4 ±3.2 kg/m². [Figure 1]
Taste impairment was most common for sour (39.3%) and sweet (31.6%) flavors, while garlic (47.0%) and rose water (42.7%) were the most affected in olfactory assessment. Cognitive function, assessed using MMSE and MoCA, showed a stepwise decline, with participants having both GD and OD exhibiting significantly lower scores (MMSE: 23.9 ±2.9, MoCA: 22.8 ±3.1, $p < 0.05$) compared to those with either dysfunction alone. [Table 1 & table 2]
Correlation analysis revealed a significant association between sensory impairment and cognitive decline, with OD showing a stronger correlation (MMSE: $r = 0.41$, $p = 0.003$; MoCA: $r = 0.38$, $p = 0.007$) than GD. [Table 3]
Multivariate analysis confirmed that sensory dysfunction remained an independent predictor of cognitive decline after adjusting for comorbidities (adjusted $p < 0.05$). These findings highlight the potential role of sensory dysfunction as an early marker for cognitive impairment in aging populations, emphasizing the need for early screening and intervention. [Table 4]

1. Correlation between Olfactory Dysfunction and Gustatory Dysfunction

	GD Present	GD Absent	Total
OD Present (n = 137)	66	71	137

- 48.2% (66 out of 137) of patients with OD also had GD.
- This suggests a moderate association between OD and GD, potentially due to shared neuro-sensory pathways.

2. Correlation between Gustatory Dysfunction and Olfactory Dysfunction

	OD Present	OD Absent	Total
GD Present (n = 84)	66	18	84

- 78.6% (66 out of 84) of patients with GD also had OD.
- This indicates a stronger directional link from GD to OD.

3. Statistical Significance

A Chi-square test was performed to assess the association:
- $\chi^2 = 18.47$, $p < 0.001$
- This confirms a statistically significant relationship between OD and GD.

4.Correlation of Sensory Dysfunction with Age

To assess the age-wise prevalence, patients were grouped into the following brackets:

Age Group (Years)	No. of Patients	GD Prevalence	OD Prevalence	Both GD + OD
60–64	60	23.3%	41.6%	15.0%
65–69	72	34.7%	56.9%	26.3%
70–74	64	42.1%	65.6%	32.8%
≥75	38	52.6%	76.3%	47.4%

A progressive increase in both GD and OD was observed with advancing age. Patients aged ≥75 years showed the highest prevalence of sensory impairments.

5. Correlation Statistics with Age

- Age vs. Gustatory Dysfunction: $r = 0.34$, $p = 0.002$
- Age vs. Olfactory Dysfunction: $r = 0.41$, $p < 0.001$

These results indicate moderate positive correlations between increasing age and sensory dysfunction. The statistical significance further supports that aging contributes meaningfully to taste and smell decline

Summary Table-

Comparison	Test Used	Statistical Value	p-value
OD vs GD (Association)	Chi-square	$\chi^2 = 18.47$	$p < 0.001$
Age vs GD	Pearson Correlation	$r = 0.34$	$p = 0.002$
Age vs OD	Pearson Correlation	$r = 0.41$	$p < 0.001$

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GD vs Cognitive Score	Pearson Correlation	r = -0.29	p = 0.004
OD vs Cognitive Score	Pearson Correlation	r = -0.38	p < 0.001

DISCUSSION:

This study reveals a considerable prevalence of gustatory dysfunction (GD) and olfactory dysfunction (OD) among the senior citizens, with rates of 35.9% and 58.5%, respectively. These findings are in line with previous research by Doty et al. [8] reported that approximately 60% of individuals over the age of 65 experience olfactory deficits, while 25–30% present with gustatory impairments. Our study closely mirror these observations, with sour (39.3%) and sweet (31.6%) tastes being the most affected, supporting Schiffman's findings that these taste modalities are particularly vulnerable to age-related decline [9].

The demographic profile of our participants (mean age: 67.8 ± 5.9 years) and the high prevalence of comorbidities such as hypertension (53.0%) and diabetes mellitus (41.9%) are comparable to those reported by Liu et al. [10], who found significant associations between chronic systemic illnesses and chemosensory dysfunction. These systemic diseases may exacerbate neural and vascular pathways involved in sensory perception, further amplifying age-related decline.

Cognitive assessments using MMSE and MoCA in our study showed significantly lower scores in participants with both GD and OD. These results corroborate findings from Roberts et al. [11], who demonstrated that olfactory dysfunction is a robust predictor of cognitive decline, even in the absence of clinical dementia. Our study also found a stronger correlation between OD and cognitive impairment compared to GD, aligning with Devanand et al. [12], who noted that olfactory testing may outperform some cognitive screening tools in early detection of Alzheimer's disease.

Multivariate analysis further reinforced the independent predictive role of sensory dysfunction in cognitive deterioration, consistent with the findings of Dintica et al. [13], who reported that sensory loss is linked to structural brain changes associated with cognitive decline. This supports the growing notion that sensory assessment, particularly of olfaction, can serve as an early, non-invasive biomarker for neurodegenerative processes.

Our findings also align with Boyce and Shone [14], who suggested that the decline in olfactory function accelerates after the age of 65, likely due to decreased receptor regeneration, olfactory bulb volume reduction, and cortical atrophy. While olfactory thresholds declined gradually across all age groups, odor identification and discrimination remained stable until a sharp decline was observed after age 65. This pattern echoes the results of Masala et al. [15] and Wilson et al. [16], indicating that odor identification and discrimination rely more heavily on higher-order brain functions, whereas thresholds are mediated by peripheral mechanisms.

The observed stronger association between cognitive decline and deficits in odor identification/discrimination—as opposed to threshold sensitivity—suggests that these subdomains are more closely tied to central nervous system integrity. This is in agreement with previous studies that identified specific correlations between olfactory discrimination performance and structural and functional alterations in the orbitofrontal cortex, amygdala, and hippocampus [17,18].

With respect to gustation, although the correlation with cognition was weaker compared to olfaction, our findings remain consistent with existing literature. The decline in bitter taste perception across all age groups and the sharp decline in salty taste perception after 65 years support the results of Stevens et al. [19], who demonstrated that bitter and salty modalities are more prone to age-related decline. Similarly, Sergi et al. [20] and Alia et al. [21] reported that oral health status, reduced salivary flow, and tongue papillae degeneration significantly contribute to taste impairment in the elderly.

Other large-scale studies, such as those by Mattos et al. [4] and Bernstein et al. [5], further confirm the associations between gustatory/olfactory dysfunction and cognitive impairment, showing similar trends across diverse population cohorts. In fact, Mattos et al. emphasized that olfactory testing could be incorporated as part of cognitive health screening in geriatric assessments, a recommendation that our data strongly support.

The study demonstrates a strong link between olfactory and gustatory dysfunctions. Furthermore, increasing age is significantly associated with both impairments. Sensory dysfunction especially olfactory may serve as a clinical warning sign or early biomarker for cognitive decline in elderly patients

CONCLUSION

This study highlights a significant association between sensory dysfunction and cognitive decline in the elderly, with olfactory dysfunction showing the strongest correlation. The prevalence of GD (35.9%) and OD (58.5%) increased with age, and both were linked to lower MMSE and MoCA scores, confirming their potential role as early biomarkers for cognitive impairment. Multivariate analysis reinforced these findings, demonstrating that sensory impairment remains an independent predictor of cognitive deterioration, even after adjusting for comorbidities. Given these results, routine sensory screening in older adults could serve as an early indicator of neurocognitive decline, enabling timely interventions and improving healthcare outcomes.

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