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CORRELATION OF OLFACTORY DYSFUNCTION WITH ALLERGIC RHINITIS- A HOSPITAL BASED OBSERVATIONAL STUDY

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Abstract:
Background: Hyposmia is a fairly common complaint in patients with long-continuing allergic rhinitis. A degree of smell disturbance has been found in seasonal and perennial allergic rhinitis, but alterations in olfaction in patients with persistent allergic rhinitis (PER) have not yet been evaluated.
Objective: To measure the prevalence of and identify the clinical characteristics associated with olfactory dysfunction in patients with allergic rhinitis.
Methods: This study conducted on 256 routine OPD patients age range between 18-60 years. It was an analytical and observational study in adult patients with a diagnosis of olfactory dysfunction with allergic rhinitis. The olfactory test used was undergone with the “Sniffin’ Sticks” test.
Results: this study was conducted on 256 patients who were previously diagnosed for allergic rhhinitis in Jammu city. Within the group of patients aged 20 to more than 51 year age range. 135 male and 121 female patient observed. The results were counted in the form of Threshold, Discrimination, Identification and TDI score. In males, 22.22% had normosmia, 44.44% had hyposmia, and 33.33% anosmia (P<0.001). In female patient, with 23.96% had normosmia, 46.28% had hyposmia, and 29.75% were having anosmia (P<0.001).
Conclusion: This study confirms the validity and reliability of The “Sniffin’ Sticks” test which is a tool suited for the routine clinical checkup of patients and for a range of additional uses in healthcare and in industry. This concludes the correlation of allergic rhinitis with olfatory dysfunction as sneezing can cause obstruction in conductive transmission of an odorant stimulus to the olfactory neuroepithelium.
Keywords*:* Allergic Rhinitis, Asthma, Hyposmia, Nasalpolyposis, Olfactory Dysfunction,

Introduction

The sense of smell plays important roles in daily human life, and loss of olfaction is mostly expressed in terms of a severe decrease in quality of life. Problems in quality of life were reported primarily in the areas of eating and safety.[1] The major causes of olfactory disorders are head injury, infections of upper respiratory tract, sinonasal diseases, head trauma, and toxic exposure.[2] Disorders of taste and smell have been difficult to diagnose and treat, often because of a lack of knowledge and understanding of these senses and their disease states. An alteration in taste or smell may be a secondary process in various disease states, or it may be the primary symptom.[3,4]

Terminology

The disorders of smell are classified as "-osmias" and those of taste as "-geusias."

- Anosmia - Inability to detect odors
- Hyposmia - Decreased ability to detect odors
- Dysosmia - Any smell alteration
- Ageusia - Inability to taste
- Hypogeusia - Decreased ability to taste
- Dysgeusia – Distorted ability to taste

Smell and taste disorders can be total (all odors or tastes), partial (affecting several odours or tastes), or specific (only one or a select few odours or tastes).

Hyposmia is a fairly common complaint in patients with long-continuing allergic or nonallergic rhinitis. Other factors such as aging, smoking, or nasal surgery may affect olfaction, but these have been little studied in rhinitis related Hyposmia.

Pathophysiology of Smell and Taste Disorders

Olfactory dysfunction:

They can be classified as conductive or sensorineural defects.

Conductive defects[5,6]

- In conductive defects, transmission of an odorant stimulus to the olfactory neuroepithelium is disrupted.
- The most common causes of primary olfactory deficits are aging, nasal and/or sinus disease, prior viral upper respiratory tract infections (URTIs), and head trauma. [12]
- Inflammatory processes like rhinitis of various types, including allergic, acute, or toxic use cause a large portion of olfactory defects.
- Chronic rhinosinusitis causes progressive mucosal disease and often leads to decreased olfactory function despite aggressive allergic, medical, and surgical intervention.
- Masses like nasal polyps, inverting papilloma, or any nasal tumour, developmental abnormalities eg, encephaloceles, and dermoid cysts may block the nasal cavity, preventing the flow of odorants to the olfactory epithelium.
- Patients with laryngectomies or tracheotomies experience Hyposmia because of a reduced or absent nasal airflow. Children with tracheotomies who were cannulated very young and for a long period may have a continued problem with olfaction even after decannulation because of a lack of early stimulation of the olfactory system.

Central/sensorineural defects[5,6]

- Infectious and inflammatory processes contribute to central defects in olfaction and transmission. Viral URTI, Sarcoidosis, Wegener granulomatosis, and multiple sclerosis also result in smell loss.
- Head injury, brain surgery, or subarachnoid haemorrhage may stretch, damage, or transect the delicate fila olfactoria or damage brain parenchyma and result in anosmia. [13]
- Congenital syndromes like Kallmann syndrome may be associated with neural losses.
- Endocrine disturbances such as hypothyroidism, hypoadrenalism, and diabetes mellitus may affect olfactory function.
- Toxicity of systemic or inhaled drugs such as amino glycosides, formaldehyde can contribute to olfactory dysfunction.
- Many other medications may alter smell sensitivity, including alcohol, nicotine, organic solvents, and direct application of zinc salts. [16]
- Various neuropsychiatric disorders like depression, seasonal affective disorder, bipolar disorder can affect olfaction.
- Degenerative processes of the central nervous system neurologic disorders like Parkinson disease, Alzheimer disease, Huntington disease, multiple sclerosis, motor neuron disease have been associated with Hyposmia.
- Loss of smell can be life threatening, impairing the detection of smoke in a fire or the ability to identify spoiled food.

We have conducted this study to correlate olfactory dysfunction with allergic rhinitis.

MATERIAL AND METHODS

This was a hospital based retrospective study performed on the data of 256 patients who were visited for the sneezing and nasal decongestion. This study was conducted in the department of Otolaryngology and Department of Physiology, Government Medical College of Jammu, in two year period from January 2017 to January 2019. The age range of patients was 18-60 years. As the study was retrospective and noninvasive, no ethical clearance was required before starting the research.

Three groups were divided by age i.e. 20-35, 36-50 and third group of 51 years and more.

Clinical measurement of taste

Many odour identification tests have been used in the literature like Barcelona Smell Test-24 (OI45), UPSIT, CCCRC test, Modified CCCRC test (with OT, OD, and OI) and many more. We decided to apply “Sniffin’ Sticks” test for olfactory capability in allergic rhinitis patients.

“Sniffin’ Sticks” test technique: Olfactory function was evaluated by the Sniffin’ Sticks. This test includes

3 tests: thresholds for butanol or phenyl ethyl alcohol odour. This is testing by means of a single staircase procedure. Second and OD i.e odour discrimination task for 16 odours (3-alternative forced choice), and an OI i.e odour Identification task for 16 odours (4-alternative forced choice). Odours are presented in felt-tip pen–like odour dispensers.

For odour presentation, the pen cap was removed by the experimenter for approximately 3 seconds and the tip of the pen was placed approximately 1–2 cm in front of the nostrils. Instead of liquid dye, the tampon of the pens for threshold testing was filled with phenyl ethyl alcohol (PEA, a rose-like odour) diluted in propylene glycol (dilution ratio 1: 2, starting at 4%). Odours were presented in a total of 16 triplets of pens, 1 containing diluted phenyl ethyl alcohol and 2 containing only propylene glycol (negative controls). The interval between presentations of individual pens of a triplet was approximately 3 seconds and presentation of the triplets to a subject occurred every 20 seconds. Employing a 3-alternative, temporal forced choice paradigm, the subjects had to identify the pen that contained the odorant. Subjects were blindfolded to prevent visual identification of the odour-containing pens.

Thresholds (T) were determined using a single-staircase technique. In the present 3-alternative, temporal forced-choice paradigm, 2 successive correct identifications of the pen containing the odour or 1 incorrect identification triggered a reversal of the staircase to the next higher or the next lower dilution step, respectively. Seven reversals had to be obtained. The odour thresholds were determined as the mean of the last 4 staircase reversals.[8,9]

For odour discrimination (D), 16 triplets of pens were presented, with 2 containing the same odorant and 1 containing the target odorant. The subjects' task was to identify the sample that had a different smell. To prevent visual detection of the target pen, subjects were blindfolded with a sleeping mask. Subjects were only allowed to sample the odour once. Presentation of triplets was separated by at least 30 seconds. The test result was a sum score of correctly identified pens.

The final step a test of odour identification was performed to completely assess the subjects' objective function [10]. Odour identification (I) was assessed by means of 16 common odours. Using a multiple forced-choice paradigm, identification of individual odours was performed from a list of 4 verbal descriptors each. Each odorant was presented by the experimenter and there was an interval of at least 30 seconds to prevent olfactory desensitization.[10]

Overall olfactory function was expressed as the sum of the scores from the 3 individual tests. Data analysis was performed by ANOVA SPSS 21.0. Demographic data of the subjects were compared by t test or chi-squared test, as appropriate categorical variables. Mean and standard deviation was applied. The level of significance was set at 0.05.

RESULT

This was a hospital based retrospective study performed on 256 patients who were visited for the sneezing and nasal decongestion. This study was conducted in the department of Otolaryngology and Department of Physiology, Government Medical College of Jammu, in two year period from January 2017 to January 2019. The age range of patients was 18-60 years. As the study was retrospective and noninvasive, no ethical clearance was required before starting the research.

Results from olfactory testing can be analyzed separately from each other.

Table 1: Sniffin´s Sticks test data denoting threshold, discrimination, identification scores and TDI score from allergic rhinitis patients of Jammu population.

Variables	Threshold	Discrimination	Identification	TDI score
Age group 20-35 (n=84)				
Mean SD	10.83±2.31	12.05±2.16	14.10±1.21	36.98±3.96
Range	4–14.	5 6–15	9–16	25.25–43.5
10th percentile	7.00	8.00	13.00	31.75
25th percentile	9.50	11.00	13.00	34.50
50th percentile	12.50	14.00	15.00	39.75
75th percentile	13.50	14.00	15.00	41.75
90th percentile	14.00	14.50	15.50	44.15
Age group 36-50 (n=84)				

Mean SD	9.41±3.42	11.81±2.06	13.54±1.30	34.76±3.58
Range	1.75–15.00	6.00–16.00	8.00–16.00	25.25–41.25
10th percentile	5.50	10.00	13.00	29.25
25th percentile	5.75	10.00	13.00	33.00
50th percentile	12.50	13.00	14.00	36.75
75th percentile	14.25	15.00	15.00	40.25
90th percentile	15.50	15.50	16.00	44.50
Age group 51< (n=88)				
Mean SD	10.59±2.79	11.53±1.93	13.38±2.65	35.49±5.00
Range	4.25–12.75	6.00–15.00	4.00–16.00	25.25–40.50
10th percentile	5.53	8.10	10.00	26.35
25th percentile	8.31	11.25	12.00	32.56
50th percentile	32.56	12.50	13.00	16.00
75th percentile	40.25	12.50	13.00	16.00
90th percentile	40.25	13.25	14.50	16.50

Results were converted into a percentage scale and results displayed inTable 1. The original answer sheet was modified to include more familiar descriptors.

The *"Sniffin' Sticks" test* was administered to 256 patients came with the prediagnosed allergic rhinitis to define normative values and the validity of the test in the Jammu population. After observing its normal distribution, a multiple regression analysis was run to predict the *"Sniffin' Sticks" test* TDI score as the dependent variable in relation to Age (r = -0.271, p<0.001) and gender (r= -0.399, p<0.001) were significant; indicating that these variables explain 30% of theTDI score variation.

Table 2: prevalence of olfactory dysfunction in allergic rhinitis patients.

Age group (years)	Male			Female		
	Normosmia (%)	Hyposmia (%)	Anosmia(%)	Normosmia (%)	Hyposmia (%)	Anosmia (%)
20-35 (84)	11(13.09)	21(25.00)	15(17.85)	10(11.90)	19(22.61)	8(9.52)
36-50 (84)	10(11.90)	19(22.62)	14(16.66)	11(13.09)	16(19.04)	14(16.66)
51< (88)	9(10.22)	20(22.72)	16(18.88)	8(9.09)	21(23.86)	14(15.90)
Total	30(22.22)	60(44.44)	45(33.33)	29(23.96)	56(46.28)	36(29.75)

Table 2 denotes correlation of olfactory dysfunction with allergic rhinitis. In 20-35 year age group; male patients, 13.09% had normosmia, 25% hyposmia, and 17.85% had anosmia (P<0.001). in female patients, 11.90% were having normosmia, 22.61% had hyposmia and 9.52% subjects were having anosmia.

In second 36-50 year age group, male patients, 11.90% had normosmia, 22.61% hyposmia, and 16.66% had anosmia (P<0.001). in female patients, 13.09% were having normosmia 19.04% had hyposmia and 16.66% subjects were having anosmia.

Third group i.e. more than 51 year old age group; 10.22% had normosmia, 22.72% hyposmia, and 18.88% had anosmia (P<0.001). In female patients, 9.09% were having normosmia 23.86% had hyposmia and 15.90% subjects were having anosmia.

DISCUSSION

This was a hospital based retrospective study performed on 256 patients who were visited for the sneezing and nasal decongestion. Normative data for age and gender was presented. The ability to discriminate healthy participants from persons with impaired olfactory ability is established and showed good reliability. And that is important not only for research but also for clinical purposes. The ability to accurately and reliably assess olfactory function has very important clinical, safety and medico-legal implications. Olfactory tests are known to have strong cultural affinities.[11,12] "Sniffin Sticks" test is reliable as it permits the study of the three components of olfaction.[6,9] We have attempted to rule out casative factors, which some have suggested to be one of the contributors to the lower rates of identifiability achieved for certain odors in the original test.

The 10th percentile of the 20– 35 year old group was used as the level at which normosmia could be distinguished from hyposmia (TDI=31.75; T=7; D=8 and I =13). The original data established a TDI of 30.3 as a separation point distinguishing normosmic and hyposmic people. Adile O. et al[10] in his study concluded similar results as we had gained.

This threshold was also similar to what has been described for the Greek population by Lotsch J et al in his study.[11] Such findings may be partly explained by the Mediterranean weather, as a warm climate may favor higher thresholds. Although a complete olfactory workup, including a TDI score, is important for research purposes and for some clinical cases, it typically is too time-consuming for use in a busy clinical setting. Deems DA et al[12] and Running CA et al[17] in his study concluded similar results. Therefore, we have also presented data on the identification score alone. The identification test was found to be a clinically suitable screening tool for the Jammu population. Infact, the current study indicates that the odor identification test is a reliable screening tool with good test-retestreliability. Mackay Sim A et al[20] in his study concluded similar results

These results suggest this approach has value as a way of differentiating between “normosmic” and “hyposmic” people. The threshold test is usually considered the most sensitive olfactory examination of overall olfactory function and seems to accurately reflect peripheral olfactory function. Nevertheless,the threshold test is characterized by considerable within-and across-participant variability inrelation toage, gender and smoking status,[21,25] as was confirmed in our test retest study. Yuan BC et al[23] in his study concluded similar results. In relation to the evaluation of a person’s olfactory capabilities, older age, male gender and active smoking status are each well-known to diminish olfactory capabilities.[4,19] Never the less these factors explain no more than about 30% of the variation in TDI score in this study. Accordingly, it seems reasonable to conclude that the TDI score is an independent predictor of hyposmia, this finding was opposite to the results concluded by Silveria ML et al.[28]

TDI and T score may be used to identify a hyposmic person. The TDI explains significant values related to the Sniffin`Sticks test (r =0.72) [6] and the UPSIT 0.98.[29] Notably, the identification test correlation, r=0.62, was lower than that observed for the German version of Sniffin`Sticks (r =0.73).[6,30] Few published studies have evaluated the reliability of supra threshold tests other than odor identification tests.[31] Hummel T et al in his study concluded siimilar results. The reliability of the discrimination subtest is r=0.71, which is higher than that of the a typical identification subtest but lower than the subtest for threshold. These findings are inline with those of other reports.[29,30] Familiarity with stimuli, a learning effect and thefeedback provided after the initial testing session, may explain the fact that retest scores tended to be higher than initial scores. Notably, the staircase method we used is known to be associated with elevated levels of false positives. Silveria ML et al[28] in his study concluded siimilar results.

The results were counted in the form of Threshold, Discrimination, Identification and TDI score. In males, 22.22% had normosmia, 44.44% had hyposmia, and 33.33% anosmia (P<0.001). In female patient, with 23.96% had normosmia, 46.28% had hyposmia, and 29.75% were having anosmia (P<0.001).

The prevalence of disorders of taste and smell in the U.S. general population has been estimated from the US National Health and Nutrition Examination Survey (NHANES) 2011-2014 protocol. A total of 3519 men and women aged 40 and older were tested with a scratch-and-sniff olfactory test; smell, taste, and combined smell and taste impairment had estimated prevalence of 13.5%, 17.3%, and 2.2%, respectively.[21,25]

When retesting thresholds, we started the test at the values attained during the previous testing session. We followed this approach in order to reduce the length of time required for testing and to lessen the opportunity for false positive to appear in responses.

CONCLUSION

This study confirms the validity and reliability of “Sniffin’ Sticks” test in the Jammu population. The study provides distinct and integral normative data for each of three age groups and for both genders. Sniffin’ Sticks test distinguishes patients from healthy subjects with high sensitivity and specificity. The “Sniffin’ Sticks” test is a tool suited for the routine clinical checkup of patients and for a range of additional uses in healthcare and in industry. This concludes the correlation of allergic rhinitis with olfatory dysfunction as sneezing can cause obstruction in conductive transmission of an odorant stimulus to the olfactory neuroepithelium.

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