

Complaints of olfactory disorders: epidemiology, assessment and clinical implications

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Purpose of review

Recent studies illuminate the difficulties that patients with olfactory disorder face in daily life, which underlines the need to understand its prevalence, and to diagnose and treat these patients. The purpose of the present review is to characterize olfactory disorders and describe associated complaints, present recent insights into epidemiology, suggest procedures to assess these disorders, and discuss clinical implications.

Recent findings

A compilation of previous and new studies of olfactory disorders suggests associated complaints of poor quality of life, depression, and various specific consequences. Epidemiological studies show that loss in odor sensitivity is common in both general and clinical populations, whereas dysosmia is less common in general populations but frequent in clinical populations. The most common etiologies are post-upper respiratory infection, nasal/sinus disease and head trauma.

Summary

Procedures to diagnose olfactory disorders and to identify etiologies are available. Depending on etiology, certain types of treatment are often successful, such as endoscopic sinus surgery and corticosteroid administration in nasal/sinus disease. In post-upper respiratory infection and head trauma, spontaneous recovery is fairly high. In any case, it is advisable to counsel the patient with regards to strategies to cope with olfactory disorders.

Keywords

etiology, loss in sensitivity, parosmia, phantosmia, prevalence

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Introduction

Olfaction plays important roles in human daily life, for example, by warning us against and attracting us towards odorous items, influencing food intake, and affecting interpersonal relations [1–4]. Etiologies underlying these disorders vary considerably in nature, including allergy-related nasal/sinus disease, head trauma and toxic exposure. The purpose of the present review is to characterize these disorders and describe associated complaints; to describe the epidemiology and identify common etiologies; to suggest procedures for assessment of olfactory disorders and associated complaints; and to discuss clinical implications.

Definitions and characteristics

Olfactory problems include loss in odor sensitivity and qualitative changes referred to as dysosmia. A loss in odor sensitivity is typically described as an impairment in detection sensitivity or in quality discrimination. A loss in either detection (resulting in weak perceived intensity) or discrimination will negatively affect the ability to

recognize and identify odorants. Although very weakly perceived intensities will compromise discrimination, studies of neuroimaging, calcium imaging and psychophysics suggest largely independent, parallel processing of odor intensity and quality discrimination [5–7]. A sensitivity loss can be quantified in terms of diminished smell sensitivity, called hyposmia, or complete smell loss, called anosmia.

Dysosmia includes both parosmia (also called troposmia) which is a qualitative odor distortion, and phantosmia (also called cacosmia) which is an odor sensation in the absence of an external odorant. From a fairly recent study of patients with a chief complaint of parosmia [8], the authors report that the parosmia sensation in all cases was unpleasant, and typically described as a ‘foul’, ‘rotten’, ‘sewage’ or ‘burn’ smell. Gasoline, tobacco and coffee were the odorants that most commonly elicited the parosmia. It was also usually associated with a loss in odor sensitivity, and the sensation was typically birhinal. Regarding phantosmia, the field lacks data of its characterization. However, Leopold [9] describes his clinical

experience with this condition as a sensation in either one or both nostrils that cannot be masked by foods.

Complaints

The understanding of the consequences of olfactory disorders has improved considerably in recent years. Poor general quality of life and depression or mood changes has been demonstrated repeatedly in patients with loss in sensitivity (Table 1 [8,10–15,16[•],17–22]). The feeling of vulnerability and general daily-life complaints have also been reported regarding this patient population. The vulnerability may be referred to as worries of and actual experience with unsafe issues (e.g. fire and gas leaks) and worries of poor personal hygiene. Table 1 further suggests that a loss in odor sensitivity has negative consequences for food intake. Thus, loss of appetite, change in food preference, change in body weight as well as cooking difficulties and poor detection of spoiled food are frequent complaints in these patients. However, in contrast to the studies suggesting a change in food preference, Doty [22] reported no overall aberrant food preference. This may be explained by the patients in that study having congenital anosmia. Interestingly, changes in body weight reported by patients with sensitivity loss include both loss and gain. The gain in weight may be due to a compensation for diminished flavor by means of larger food intake. Loss in sensitivity has also been found to be associated with a decrease in social interaction with friends and colleagues, and in intimacy with a partner (Table 1).

The sensation distortion in parosmia and the phantom sensation in phantosmia are valid sources of serious complaints per se. Regarding other consequences of these

conditions, the understanding has improved somewhat over the past few years of parosmia and dysosmia in general, whereas no published data are available specifically for phantosmia. Results from studies listed in Table 1 indicate depression and change (loss) in body weight in dysosmia. Two studies of parosmia suggest poor general quality of life, daily-life complaints, and flavor distortion. Although the impact of dysosmia appears to differ largely between patients, there are case reports of potentially lethal appetite and weight loss in parosmia, and ‘unbearable and horrible’ odor sensation, extensive hygiene and social isolation in phantosmia [23,24]. Dysosmia is usually more disruptive to the individual than a loss of sensitivity [13,14].

Epidemiology of olfactory disorders

For a broad understanding of the epidemiology of olfactory disorders it is necessary to view this from the perspective of both general and clinical populations. Both perspectives are provided below.

General populations

The prevalence of a dysfunctional sense of smell, primarily due to loss in sensitivity, has from population-based studies, by means of test of cued odor identification, been reported to be 19.1% (hyposmia 13.3%, anosmia 5.8%) in adults aged 20 years and older [25], and 24.5% in adults aged 53 years and older [26]. Similar prevalences have been obtained from a non-population-based but large study of individuals aged 5–86 years [27]. Importantly, a large proportion of the cases in these studies constitute the elderly. The prevalence of self-reported poor odor sensitivity has been reported to be only 15.3% in the general population

Table 1 Studies in the reference list from which different types of complaints associated with olfactory disorders have been reported

Complaint	Reference		
	Sensitivity loss	Parosmia and/or phantosmia	Parosmia
General			
Poor general quality of life	[10–13]	–	[13]
Depression or mood changes	[11,12,14]	[14]	–
Feeling of vulnerability	[15]	–	–
Daily-life difficulties	[13,15]	–	[13]
Safety			
Worrying about fire and gas leaks	[10,12]	–	–
Having experienced hazardous events	[17]	–	–
Personal hygiene			
Worrying about perfume and cologne use	[10,12]	–	–
Worrying about personal body odor	[11,12]	–	–
Food-related			
Change in appetite and/or food preference ^a	[10–12,18,19]	–	–
Change in body weight	[20,21]	[20]	–
Difficulties in cooking and detecting spoiled food	[10–12]	–	–
Flavor distortion	–	–	[8]
Social interaction			
Deteriorated relationship with friends and colleagues	[12,15,16 [•]]	–	–
Deteriorated relationship with partner	[12,15,16 [•]]	–	–

^aNo overall change in food preference in patients with sensitivity loss was reported by Doty [22].

of adults [28]. The discrepancy between olfactory test performance and self-report may be explained by older adults often being unaware of their gradual decline in odor sensitivity [29,30].

Dysosmia is far less common than sensitivity loss in the general population. A recently published population-based study of parosmia yielded a prevalence of 4.0% in the adult population and 3.4% in teenagers [31]. A parosmia prevalence of slightly smaller size, 2.1%, was reported by Landis *et al.* [27]. The difference in prevalence between studies may be due partly to the participants in the latter study being screened for nasal/sinus disease. The prevalence of phantosmia was in this latter study found to be 0.8%.

A few population-based studies have also identified risk factors for a loss in odor sensitivity. These factors are epilepsy [odds ratio (OR) 4.1], old age (OR 2.9), nasal polyps (OR 2.1–3.8), diabetes mellitus (OR 2.6), depression (OR 2.3), trouble with hearing (OR 2.3), current smoking (OR 2.2), stroke (OR 2.0), male gender (OR 1.7–1.9), and nasal congestion or post-upper respiratory infection (URI) (OR 1.6) [25,26,32].

Clinical populations

Murphy *et al.* [33] have listed over 200 etiologies for olfactory disorder. The mechanisms underlying these disorders can be classified as conductive (e.g. polyposis), sensorineural (e.g. post-URI) or impairment in the olfactory central nervous system (e.g. tumor). Studies of the prevalence of olfactory disorders in consecutive cases at olfactory clinics in the USA, Europe and Japan are summarized in Table 2 [14,16[•],34,35^{••},36,37] for the most common etiologies: post-URI (18–45% of the clinical population) followed by nasal/sinus disease (7–56%), head trauma (8–20%), toxins/drugs (2–6%) and congenital loss (0–4%). The large variance in prevalence between studies is likely to be predominantly due to different criteria for patient inclusion. A novel study of 1000 consecutive patients does suggest further that etiology prevalences vary with age and gender [38].

The prevalence of loss in odor sensitivity is very high (67–100%) in all these etiologies among patients presented to clinics (Table 2). Whereas the pathogeneses of the most common etiologies of loss in odor sensitivity are fairly well documented [39], there has been uncertainty of the toxic agent in post-URI (virus, bacteria or an

Table 2 Prevalences in percentage of olfactory disorders for various etiologies in clinical populations

Etiology	Percentage of clinical population with etiology	Percentage of etiology underlying the symptom				Reference
		Sensitivity loss	Parosmia and/or phantosmia	Parosmia	Phantosmia	
Post-upper respiratory infection	27	95	52	48	5	[16 [•]] ^a
	26	76	35	–	–	[14] ^b
	25	–	51	39	30	[34] ^c
	45	–	–	56	14	[35 ^{••}] ^d
	27	–	–	–	–	[36] ^e
	18	–	–	–	–	[37] ^f
Nasal/sinus disease	14	98	17	7	10	[16 [•]] ^a
	15	72	28	–	–	[14] ^b
	48	–	26	3	23	[34] ^c
	7	–	–	28	7	[35 ^{••}] ^d
	56	–	–	–	–	[36] ^e
	14	–	–	–	–	[37] ^f
Head trauma	10	94	29	26	13	[16 [•]] ^a
	18	86	40	–	–	[14] ^b
	8	–	55	35	41	[34] ^c
	20	–	–	20	14	[35 ^{••}] ^d
	12	–	–	–	–	[36] ^e
	18	–	–	–	–	[37] ^f
Toxins/drugs	2	67	28	–	–	[14] ^b
	5	–	17	17	17	[34] ^c
	3	–	–	–	–	[36] ^e
	6	–	–	–	–	[37] ^f
Congenital	4	100	0	–	–	[14] ^b
	4	–	0	0	0	[34] ^c
	0	–	–	–	–	[36] ^e
	3	–	–	–	–	[37] ^f
Idiopathic	34	93	26	14	14	[16 [•]] ^a
	22	53	33	–	–	[14] ^b
	4	–	56	31	38	[34] ^c
	0	–	–	10	14	[35 ^{••}] ^d
	3	–	–	–	–	[36] ^e
	27	–	–	–	–	[37] ^f

Patient-inclusion criterion: ^achief complaint of olfactory disorder, ^bdiagnosed with chemosensory disorder, ^cchief complaint of nasal/sinus disease and/or olfactory disorder, ^ddiagnosed with olfactory disorder. Total $n = ^a303, ^b750, ^c363, ^d392, ^e889, ^f428$.

immune response). However, in a newly and carefully conducted study of patients with sensitivity loss due to post-URI, the investigators were able to identify several types of virus: human rhinovirus, picornavirus, parainfluenza virus type 2, human coronavirus and Epstein–Barr virus [40[•]].

Although less frequent than loss in sensitivity, dysosmia is present in a rather large proportion of these patients: it was most prevalent in head trauma (29–55%) and post-URI (35–51%), followed by nasal/sinus disease (17–28%) and toxins/drugs (17–28%), but not present in congenital loss. Table 2 does further suggest that post-URI is the most common cause of parosmia, and that head trauma and post-URI are the most common causes of phantosmia. It is obvious that the prevalence of dysosmia reported from different chemosensory clinics differs considerably, which may mainly be due to use of different diagnostic procedures. What the table does not show is that roughly one-third of the patients with dysosmia also have a loss of sensitivity.

There is as yet only sparse understanding for the pathogenesis of dysosmia, although various possible causes have been proposed: a partial loss of olfactory receptor neurons resulting in the inability to form a complete ‘picture’ of the odorant, or to pathology in integrative or interpretive central nervous system areas [9]. Others have hypothesized a loss in olfactory bulb neurons due to decreased lateral inhibition caused by interneuronal loss [41]. Regarding phantosmia, hyperactive olfactory receptor neurons or cells of the central nervous system, and inhibitory neuron loss have been suggested as candidate causes, as well as phantosmia being triggered by a nasal sniff [9]. Clearly, future research needs to focus on the pathogenesis of parosmia and phantosmia to provide treatment.

Assessment

Clinical evaluation of the sense of smell often includes an anamnesis, perceptual or psychophysical tests of olfactory performance, assessment of the patient’s complaints, and a physiological and anatomical evaluation to identify underlying causes.

Anamnesis

For accurate diagnosis it is important to question the patient about the nature, timing, onset duration and pattern of their symptoms, as well as a historical determination of antecedent events [33]. The Multi-Clinic Smell and Taste Questionnaire (MCSTQ) [42] can be useful for this purpose, and consists of questions pertaining to medical history as well as to abnormal smell sensitivity, parosmia and phantosmia.

Tests of olfactory performance

A test of the ability to identify (name) odorous items is commonly used in clinical settings since it indicates whether there is impairment in one or several key olfactory functions. Thus, odor identification requires intact detection sensitivity (assumed to underlie relatively strong odor sensation), quality discrimination and recognition. Due to the need to use culturally relevant test odorants to assess odor identification, tests for different geographic regions have been developed with demonstrated validity and reliability, and with normative data. Such regions include the USA [43,44], Central Europe [45], Scandinavia [46], and Japan [47]. Although accurate odor identification also depends on cognitive functions, their contribution to predicted identification performance in nondemented populations is small [48]. Tests of olfactory detection sensitivity and quality discrimination are important complementary tests to odor identification since they provide specific information of the olfactory impairment underlying poor identification. Valid clinical tests for these purposes are the CCCRC Detection Test [44] and the Sniffin’ Sticks [45]. The latter test can – in addition to odor identification – be used to separately assess detection and discrimination.

Olfactory complaints

In many clinical situations it is important to weigh possible side effects of possible treatment against consequences of the medical condition, which highlights assessment of the individual’s medical complaints. Regarding general consequences of olfactory disorders, several validated questionnaires are useful to assess quality of life and depression [49], such as the Beck Depression Inventory [50], the Short Form-36 Health Survey [51] and the General Well Being Schedule [52]. For more elaborate investigation of consequences of olfactory disorders, the Questionnaire of Olfactory Disorders [13] is available with three domains: degree of suffering, positive effects and coping strategies, and social desirability (‘lie scale’).

When asking questions about loss in odor sensitivity, parosmia and phantosmia it is important that these terms are described carefully to the patient. Examples of such descriptions from the MCSTQ are ‘how strong you perceive things to smell’ (odor sensitivity), ‘certain things smell qualitatively different from what they usually do; for example, a perfectly normal orange smells like mud’ (parosmia), and ‘you perceive a smell although there is nothing to produce the smell’ (phantosmia) [42].

Physiological and anatomical evaluation

Objective measures of olfactory function, such as olfactory event-related potentials (OERPs) and the electro-olfactogram (EOG) may provide valuable information. OERPs are recorded noninvasively over the scalp from electromagnetic fields generated from cortical

neurons, and provide information about neuronal allocation and processing speed with very high temporal resolution [53]. The EOG is a single potential that is the sum of activated olfactory receptor neurons [54]. In contrast to OERPs, EOG recording requires a rather invasive procedure, but its use may be motivated when functional evaluation of the olfactory epithelium is necessary. Additional evaluation is critical for identifying the etiology of the olfactory disorder, such as nasal endoscopy by use of flexible or rigid rhinoscopy for visualizing the nasal cavity, and general neurological examination of the cranial nerves II–V, VII–IX and XII. MRI may provide useful information for detecting inflammatory processes and other obstructions in the nose and sinuses, and tumors and lesions in the neural olfactory pathways.

Clinical implications

How successful treatment of an olfactory disorder will be, and to what extent there will be spontaneous recovery varies considerably between disorders and etiologies. The prognosis of loss in sensitivity due to rhinosinusitis after endoscopic sinus surgery has been reported to be rather good [55,56]. Antibiotics can in some cases be used to treat acute sinusitis as a result of infections, and corticosteroids in sinus/nasal disease as an anti-inflammatory drug [39]. Long-term improvement in olfactory function and other nasal/sinus symptoms in polyposis patients was recently demonstrated after a combination of endoscopic sinus surgery and corticosteroid administration [57]. Although there is yet sparse data from humans, there are indications that toxic-induced olfactory disorders may recover once the exposure terminates [58]. No pharmacological therapy is yet available to treat post-URI [39], but spontaneous recovery from loss in odor sensitivity due to post-URI and head trauma is quite common, predominantly within the first year [33,59]. In contrast, recovery in age-related and congenital olfactory loss is very poor [39].

It is commonly believed that parosmia and phantosmia tend to diminish over time. However, results from a contemporary study show that only 29% of patients with parosmia and 53% with phantosmia reported relief in symptoms within the first year [35]. Leopold [9] has suggested certain procedures when the patient is unwilling or unable to wait. In some cases blockage of distorted perception with topical nasal saline drops may help. A more drastic procedure is olfactory bulb or nerve removal, resulting in permanent anosmia. He does also describe a successful procedure of excision of the olfactory epithelium. Others have proposed use of a nose clip to abolish the parosmia to enable oral food intake in severe cases [24].

It is important to counsel the patient with an olfactory disorder regarding safety issues (e.g. use of smoke detec-

tors) and to encourage use of coping strategies. Common strategies used by patients with these disorders include having a family member taste food that might be spoiled, seeking information about olfactory disorders, asking others to check whether the right amount of perfume or after shave is applied, and comparing the problems with those who are worse off [12,15].

Conclusion

Olfactory disorders have a negative impact on daily life, and loss in odor sensitivity is rather common in the general population, whereas dysosmia is less common in the general population but frequent in populations at olfactory clinics. The success rate of treatment and the likelihood of spontaneous recovery vary considerably between disorders and etiologies. The adverse consequences of olfactory disorders and their high prevalence calls for future research in treatment of these disorders, primarily for the most common etiologies: post-URI, nasal/sinus disease and head trauma. There is particular need for better understanding for the pathogenesis of dysosmia.

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References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (p. 89).

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