

Olfactory Disorders and Quality of Life—An Updated Review

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Abstract

Olfactory disorders are common and affect about one-fifth of the general population. The main causes of olfactory loss are post viral upper respiratory infection, nasal/sinus disease, and head trauma and are therefore very frequent among patients in ear, nose, and throat clinics. We have systematically reviewed the impact of quantitative, qualitative, and congenital olfactory disorders on daily life domains as well as on general quality of life and depression. From the extensive body of literature, it can be concluded that loss of the sense of smell leads to disturbances in important areas, mainly in food enjoyment, detecting harmful food and smoke, and to some extent in social situations and working life. Most patients seem to deal well and manage those restrictions. However, a smaller proportion has considerable problems and expresses a noticeable reduction in general quality of life and enhanced depression. The impact of coping strategies is discussed.

Key words: Depression, olfaction, prevalence, quality of life, smell

For normosmic people, it is hard to imagine what life would be like without olfaction. Many physicians seem rather helpless in what to tell patients with olfactory disorders. The current review aims to give some guidance of what restrictions in daily life can be expected and how quality of life changes (QoL) in persons with olfactory disorders. We start with a brief overview about the function of olfaction, prevalence, and causes of olfactory disorders and continue with a detailed discussion about the consequences of olfactory disorders in domains where olfaction plays a major role. Furthermore, the impact of acquired quantitative, qualitative, and congenital olfactory disorders on general QoL as well as coping mechanisms is reported. A special section focuses on olfactory disorders among older people.

The role of olfaction

The general role of olfaction is to guide our attention towards hazards (e.g., microbial threats and poisonous fumes) and towards items with positive connotations (e.g., nutritious food). This guidance is predominantly driven by the valence (pleasantness/unpleasantness) of the odorous item (e.g., food), which—to a large extent—is determined

by the individual's personal history with that item. To various degrees (see also Khan et al. 2007; Lapid et al. 2011; Kermen et al. 2013), odor preferences result from a learning process. At an earlier encounter with the food we associate its odor with a positive or negative emotion, and at the later occasion we recognize the odor and retrieve the association from memory (Engen 1991; Rolls 2004). Thus, the relatively strong positive or negative emotions often evoked by smells are shaped by prior experience and are believed to enhance the appropriate behavioral response.

Olfaction plays a major role in food intake, such that odors assist in food localization and indicate the food's edibility (Stevenson 2010). Important for food perception, the odorous molecules can also reach the epithelium from the oral cavity through the retronasal passage, which is enhanced by movements of the tongue, cheek, and throat that pump the molecules through this passage (Burdach and Doty 1987). A discrepancy between perceived flavor and expectation formed prior to ingestion can lead to rejection of the food. Several olfactory-related mechanisms are involved in appetite regulation by affecting our decisions on when, how much, and what to eat (Nordin 2009).

Olfaction may also be involved in social communication. Odors have been reported to have an impact on reproductive

behavior, including inbreeding avoidance and mate selection as well as emotional contagion (Stevenson 2010). The latter refers to the ability to detect fear-related cues (Ackerl et al. 2002; Prehn-Kristensen et al. 2009). Another example of this social function has been shown in a recent study in which female tears were demonstrated to contain chemical signals that decrease sexual arousal and testosterone levels in men (Gelstein et al. 2011).

Types of olfactory disorders and prevalence

Types of olfactory disorders.

Using appropriate tools (e.g., the “University of Pennsylvania Smell Identification Test,” or the “Sniffin’ Sticks”), quantitative smell disorders (anosmia, hyposmia) can be differentiated from normal olfactory function. Whereas most olfactory disorders are acquired, there are some patients who were born without a sense of smell, so-called congenital anosmia. In those patients, the olfactory bulb is typically hypoplastic or aplastic and accompanied by a shallow olfactory sulcus (Abolmaali et al. 2002). Some patients also exhibit qualitative olfactory disorders. Such disorders may be divided into parosmias and phantosmias—often characterized as unpleasant sensations (Leopold 2002). Parosmias are distorted odor perceptions in the presence of an odor source; phantosmias are odor percepts in the absence of an odor (Frasnelli et al. 2004). Phantosmias and parosmias are typically caused by classical causes of olfactory loss, for example, sinunasal disease, infections of the upper respiratory tract, or head trauma (Landis et al. 2005). Qualitative olfactory disorders seem to occur during states of neuronal degeneration or regeneration (Leopold 2002). However, phantom odors occur in psychiatric or neurological diseases; phantosmias may also occur in isolation as a single symptom (Pryse-Phillips 1971; Frasnelli et al. 2004; Frasnelli and Hummel 2005).

Prevalence of olfactory disorders.

Population-based studies of olfactory loss indicate a prevalence of 22% (25–75 years; Vennemann et al. 2008), 19% (≥ 20 years; Bramerson et al. 2004), or 24% (≥ 53 years; Murphy et al. 2002), with highest prevalence in older men. However, unawareness of olfactory loss is common (Nordin et al. 1995; Murphy et al. 2002; Shu et al. 2011) perhaps because olfactory information is processed unconsciously to a relatively large extent. Consequently, the prevalence of self-reported smell loss varies between 1.4% and 15% (Hoffman et al. 1998; Murphy et al. 2002; Nordin et al. 2004).

The most common etiologies of smell loss are post viral upper respiratory infection (URI) (18–45% of the clinical population) and nasal/sinus disease (7–56%) followed by head trauma (8–20%), exposure to toxins/drugs (2–6%), and

congenital anosmia (0–4%) (Nordin and Bramerson 2008). A survey specific for Germany, Austria, and Switzerland shows similar results (Damm et al. 2004). Regarding how common smell loss is among different medical conditions, the percentage of patients with clinically proven smell loss is rather high: 76–95% in post viral URI, 72–98% in nasal/sinus disease, 86–94% in head trauma, 67% in exposure to toxins/drugs, and 100% in congenital cases (Nordin and Bramerson 2008). Loss due to post viral URI, head trauma, and exposure to toxins/drugs is to some degree reversible (Duncan and Seiden 1995; Reden et al. 2006), whereas many cases of nasal/sinus disease can be treated with medication or with a combination of conservative and surgical treatment (Seiden et al. 1992). Further information about the treatment of olfactory disorders can be found elsewhere (Hummel et al. 2011; Welge-Luessen and Hummel 2013).

The prevalence of congenital anosmia is estimated at 1:5000–10000 (Croy et al. 2012), and this disorder is frequently overlooked. We learned from our patients that approximately 13 years passed between the time when the disorder was noticed first (at about the age of 10 years) and the final diagnosis (Bojanowski et al. 2013).

For qualitative disorders, the prevalence is considerably lower than for quantitative disorders. In the general population, the prevalence of phantosmia is estimated between 0.8% and 2.1% (Landis et al. 2004) and parosmia to ~4% (Nordin et al. 2007). Among patients with olfactory disorders, parosmia may range from 10% to 60% (Deems et al. 1991; Nordin et al. 1996; Falcon et al. 1999; Quint et al. 2001)—possibly indicating that the detection of parosmia is critically dependent on how the investigator asks for parosmia.

Consequences of olfactory disorders

Assessment of daily life problems in olfactory disorders and general QoL

Keller and Malaspina recently collected 1000 case reports giving very illustrative descriptions of daily life with olfactory disorders (Keller and Malaspina 2013). Several questionnaires have been developed to detect specific changes related to olfactory loss systematically (cf. Table 1 for overview). Results from those questionnaires form the base for the next chapter “Olfactory disorders and daily life functions.”

Coping with olfactory disorders has been measured using a coping checklist (Lazarus and Folkman 1984). In addition, Nordin et al. (2011) introduced a questionnaire consisting of 5 problem-focused and 6 emotion-focused questions about coping with the olfactory loss.

General QoL can be assessed with questionnaires, such as the Short Form-36 Health Survey (Ware 2000), the General Well-Being Schedule (McDowell 2006), the 90-item Symptom Checklist (Derogatis 1977), the Mood Inventory (Zessen 1975), and the Nottingham Health Profile (Wiklund

Table 1 Questionnaires measuring changes related to olfactory loss

Reference	Description
Anderson et al. (1999)	Sinonasal Outcome Test-16 Specifically addressing nasal dysfunction
Croy et al. (2010)	Importance of olfaction Addressing associations, applications, and consequences of olfaction in daily life
De Jong et al. (1999)	Appetite, hunger, subjective taste, and smell questionnaire Measuring those functions nowadays compared with past perception
Frasnelli and Hummel (2005); Neuland et al. (2011)	Questionnaire of Olfactory Disorders Assessing daily life problems associated with olfactory loss
Hufnagl et al. (2003)	Questionnaire for the assessment of self-reported olfactory functioning
Miwa et al. (2001)	Questionnaire on the impact of olfactory impairment on quality of life and disability Measuring impairment in 15 olfactory-related daily life activities and general enjoyment of life
Nordin et al. (2003)	Scandinavian adaptation of the Multi-Clinic Smell and Taste Questionnaire Assessing consequences of olfactory dysfunction
Pusswald et al. (2012)	Brief Self-Report Inventory to Measure Olfactory Dysfunction and Quality of Life Assessing the subjective general and odor specific olfactory function and olfaction related quality of life
Takebayashi et al. (2011)	Self-administered odor questionnaire Measuring how strong each of 20 odors are perceived
Varga et al. (2000)	Impact of chemosensory disorders on everyday life Assessing specifically olfactory-related changes in Quality of life

et al. 1988) (for overview see Bullinger 2002). Indications for depressive symptoms are often assessed with the Beck Depression Inventory (BDI) (Beck et al. 1961) or its more recent version (Beck et al. 1996). In using those measurements, one has to be aware that olfactory loss is often confounded with comorbidity. So, it is difficult to determine whether QoL reduction is due to the olfactory or the comorbid disorder. At least in patients with olfactory loss due to sinonasal disease, a major component of the decrease in QoL is related to decreased patency of the nasal airways, which severely contaminates the results obtained with these questionnaires. Chronic rhinosinusitis alone, for instance, has an impact on QoL, and comorbidities, such as asthma and allergies, have cumulative negative effects (Alobid et al. 2008). One study in patients with chronic rhinosinusitis even indicates that the additional effect of olfactory loss on general QoL is negligible (Litvack et al. 2009). However, daily life restrictions from olfactory loss may easily be overseen, if not specifically asked for.

Olfactory disorders and daily life functions

Patients with olfactory disorders are impaired in areas of food intake, safety, personal hygiene, and in their sexual life (cf. Tennen et al. 1991; Van Toller 1999; Hummel and Nordin 2005) (Figure 1).

Most often, “difficulties related to eating” are examined and reported in patients with olfactory disorders. The perceived

taste of food is strongly determined by olfactory experience, and a lack of the sense of smell consequently reduces the richness of food perception. A congenital anosmic woman recently gave an illustrative example of this: “I had many lunchtime meetings with academics who drank wine enthusiastically and enjoyed talking about it. I listened to them carefully and also read the labels on the bottle, which are a great literary genre, with fascinating poetical descriptions of taste, and I imagined the vineyards in the sunshine and old oak barrels in cellars. But when I drank, I only noticed a bitter sensation that was not particularly pleasant.” (Tafalla 2013).

Ferris and Duffy found that 69% of their patients ($n = 239$) enjoyed food less than before onset of the disorder (Ferris and Duffy 1989) (see also Varga et al. 2000; Hufnagl et al. 2003; Keller and Malaspina 2013). The reduced experience of food quality led to diminished appetite in 27% of their patients. Reduced appetite was also stated by 27% ($n = 50$) (Nordin et al. 2011), 32% ($n = 72$) (Blomqvist et al. 2004), and even 56% ($n = 278$) (Temmel et al. 2002) of patients. The actual eating behavior seems to depend on coping mechanisms. Patients report to increase the taste by using more salt, sweetener, or irritants/spices as well as valuing the texture more. One patient reported, “I ended up gaining almost twenty pounds before realizing I was consuming more of every food in an effort to taste it” (Keller and Malaspina 2013). Studies show that the percentage of patients reporting to eat more varies between 3% and 20%, and between 20% and 36% report to eat less since the onset of the olfactory

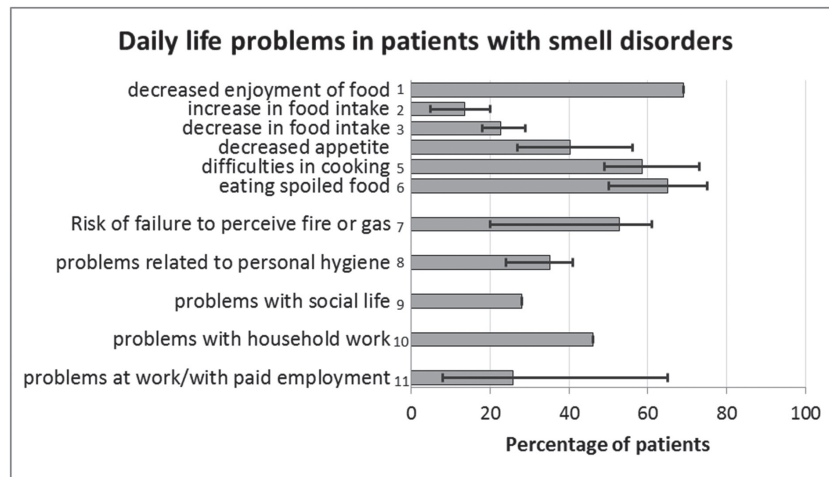


Figure 1 Daily life problems in patients with smell disorders. Results of 8 studies are included. The bars visualize the mean percentage of patients affected, weighted by the number of participants per study. The error bars show the lowest and highest reported percentage in the studies. The calculation is based on the following studies: [Temmel et al. \(2002\)](#), $n = 278$ (items 4–6, 8, 11); [Tennen et al. \(1991\)](#), $n = 66$ (item 8); [Miwa et al. \(2001\)](#), $n = 420$ (items 5–8); [Nordin et al. \(2011\)](#), $n = 50$ (item 4); [Ferris and Duffy \(1989\)](#), $n = 230$ (item 1–4); [Brämerson et al. \(2007\)](#), $n = 102$, (items 9–11); [Blomqvist et al. \(2004\)](#), $n = 72$ (item 4); [Aschenbrenner et al. \(2008\)](#), $n = 176$ (items 2,3).

disorder ([Ferris and Duffy 1989](#); [Aschenbrenner et al. 2008](#); [Keller and Malaspina 2013](#)). The numbers imply that a large percentage of these patients have problems in maintaining their original eating behavior. However, it is rather unclear why some patients keep their weight, whereas others eat either less or more after food have become “tasteless.” Coping mechanisms like eating after time schemes and enriching food by other sensory information, such as texture and color, are often reported to be helpful.

It is unclear whether patients with parosmia or phantosmia are more affected than those with a quantitative disorder. In the study of [Aschenbrenner et al. \(2008\)](#), food consumption was not different between patients with quantitative versus qualitative olfactory disorders. On the other hand, patients with parosmia and phantosmia are reported to exhibit specific dislikes towards foods ([Mattes et al. 1990](#)), and single-case reports relate phantosmia to severe weight loss (e.g., [Muller et al. 2006](#)). No significant weight difference, and no difference in food preferences, was found in patients who were born without the sense of smell in comparison to an age-matched control group ([Croy et al. 2012](#)). This is also supported from observations, indicating that congenital absence of olfaction does not result in markedly aberrant food preferences ([Doty 1977](#)).

Food-related problems are not limited to eating; preparation of food is difficult for many patients with olfactory disorders. Problems with cooking have been reported in 49% ($n = 420$) ([Miwa et al. 2001](#)) and 73% ([Temmel et al. 2002](#)) of the patients. In those studies, half and two-thirds of the patients, respectively, had problems detecting spoiled food ([Miwa et al. 2001](#); [Temmel et al. 2002](#)). [Santos et al. \(2004\)](#) asked about hazardous events: 37% of their patients (total $n = 445$) reported at least one such

event, and cooking-related hazards were reported most often followed by detecting spoiled food. Despite having acquired better coping mechanisms ([Bojanowski et al. 2013](#)), congenital anosmic persons also report enhanced problems with detecting burning food and spoiled food ([Croy et al. 2012](#)).

Another common problem is the “failure to detect fire, gas or smoke”, which is reported by 61% of the patients ([Miwa et al. 2001](#)). A congenital anosmic women, for instance, told us, “My husband was a policeman who worked a lot of night shifts, leaving me alone at night with the children. Until my oldest children were old enough to be reliable, I worried constantly about gas leaks and fire in the night when I wouldn’t be able to detect them until it would be too late. Once my older children got about 8–10 years old and understood the importance the lack of smell made to our safety at night, I felt much safer.” Twenty percent of the smell patients describe not having been able to detect fire related smoke ([Haxel,et al. 2012](#)) and even more worry about potentially not detecting such a danger. The failure to detect fire or smoke was described as the main risk associated with olfactory disorders by 38 to 45% of the patients ([Blomqvist et al. 2004](#); [Nordin et al. 2011](#)).

Furthermore, patients typically express problems related to “personal hygiene”. They worry about their body odor, bad breath, and their children’s hygiene: “My 8 children all learned very early to tell me when their diapers needed changing, and another way I coped with that was to check them almost constantly.”

Worry about not being able to perceive the own body odor was reported by 41% of the patients of [Temmel et al. \(2002\)](#). In 2 studies, 19% and 36% of the patients described being less aware of personal hygiene as the most negative effect of

the olfactory disorder (Blomqvist et al. 2004; Nordin et al. 2011). In line with this, 33% of the patients of Miwa et al. (2001) stated problems in using perfume.

Maybe related to insecurity about personal body odor, “social relations” are reported to be affected by olfactory disorders. One-fourth to one-third (Tennen et al. 1991) of the patients report such problems (Varga et al. 2000; Bramerson et al. 2007; Nordin et al. 2011). Impaired sex life has been reported by Hufnagl et al. (2003), but Brämerson et al. (2007) found no enhanced sexual problems compared with a control group. Depression and gender might be moderating factors. In the study of Gudziol et al. (2009), patients reported small but significantly reduced sexual appetite after, compared with before, the onset of the smell disorder. This was more pronounced in men with more severe depression. The same gender effect was found in congenital anosmic patients. Men born without a sense of smell described a reduced number of sexual relationships (Croy et al. 2013).

Problems in “working life” have been reported by 8% (Temmel et al. 2002) up to about one-third of the patients (Bramerson et al. 2007), depending on the question asked. Whether olfactory impairment interferes with working life depends on profession. Reduced ability in working was described as the main interference of olfactory disorder in daily life by 3–8% of the patients (Blomqvist et al. 2004; Nordin et al. 2011). For persons working as cooks or wine tasters, perfumers, nurses or firemen, olfactory disorders can be catastrophic. Haxel et al. (2012) asked their patients specifically about consequences for working life. Only 35% of their patients continued working without restrictions, 60% of their patients needed special adjustments on their job, and 5% of the patients reported not being able to work anymore in their former profession.

General QoL and Depression

Olfactory disorders impair QoL, and we propose 2 potential pathways (see Figure 2). First, it is reasonable to assume that the aforementioned daily life restrictions impair QoL and enhance the likelihood of depression. Reduced food enjoyment and social security as well as worries about personal hygiene may reduce participation in social life and make persons more prone to depression. Worries about the professional future may add to this. Secondly, it is likely that olfactory loss per se affects the brain’s functioning and, especially, emotional control. A potential mechanism is the reduced input from the olfactory bulb via amygdala into the limbic circuit (cf. Leonard 1984; Kelly et al. 1997; Masini et al. 2004; Song and Leonard 2005, for studies on rodents, and Deems et al. 1991; Temmel et al. 2002; Pause et al. 2003; Croy et al. 2011; Landis et al. 2012, for studies on humans).

About one-fourth to one-third of patients with smell disorders exhibit depressive symptoms. Deems et al. (1991) found that 25% of their 750 patients reported BDI scores in the range of mild to severe depression. Among the patients

with accompanying parosmia or phantosmia, 35% exhibited high depression scores. Similarly, Tennen et al. (1991) showed that a feeling of vulnerability was the single most stressful aspect of an olfactory disorder, as reported by 28% of 196 investigated patients. BDI scores indicating moderate depression were found in 17% of their patients. Miwa et al. (2001) report that 25% of their patients enjoyed life less than before the disorder onset. A similar high proportion of reduced QoL was reported in 2 other studies: 27% and 30% of the patients of Blomqvist et al. (2004) and Nordin et al. (2011), respectively, indicated severe distress in the General Well Being Questionnaire. This might be related to coping. Twenty-seven percent of the patients of Nordin et al. (2011) did not agree to the statement “do you accept the situation and try to make the best out of it.” Among 32 patients, who were born without the sense of smell, 29% report BDI scores in the range of mild to severe depression (Croy et al. 2012).

Reduced QoL in olfactory-specific domains and in general health was also reported in a study ($n = 205$) by Frasnelli and Hummel (2005). Importantly, QoL was reduced even more in parosmia/phantosmia patients. Also, Bonfils et al. (2005) found that half of their 56 patients with parosmia and moderate to severe olfactory loss reported severely affected QoL.

In a study in people with self-reported loss of smell ($n = 90$), enhanced depression and reduced QoL based on the SF-36 was found in over 20% of the respondents (Smeets et al. 2009). A very high proportion, namely 68%, of the patients of Temmel et al. (2002) have been reported to exhibit signs of depressed mood assessed with a single item only—which might explain the difference to other studies. However, the authors found that those patients with signs of depressed mood had significantly higher complaints about olfactory-related daily life problems.

Coping with the olfactory deficit

The majority of patients develop strategies to adjust to the olfactory disorder. Patients with parosmia and phantosmia have increased problems in coping compared with patients with only quantitative disorders (Frasnelli and Hummel 2005). Tennen et al. (1991) analyzed different coping strategies in patients and came to the conclusion that the strategy used to cope with the olfactory loss and the appraisal of the loss contributes to psychological well-being. Problem- and emotion-focused coping strategies are applied by about 80% of the patients (Nordin et al. 2011). For instance, trying to accept the situation and making the best out of it is the emotional coping strategy used by most of the patients. Asking family members for support in tasting food are problem-focused strategies used by a similar high proportion of about two-thirds of the patients (Blomqvist et al. 2004). Another coping mechanism frequently reported is the purchase of gas and smoke detectors.

In a study including 235 patients, we found adjustment to impaired olfactory function by giving this domain less

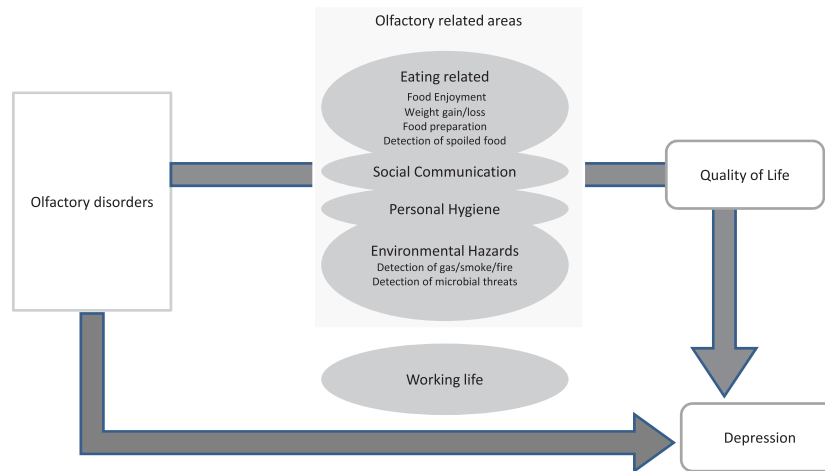


Figure 2 Pathways of depression in olfactory disorders. Olfactory impairment leads to restrictions in olfactory-related areas, which can affect Quality of life and, by this pathway, enhance depression likelihood. Working life is directly affected in professions depending on olfactory ability, such as perfumers, firemen, or cooks. However, working life is also impaired in professions where olfactory-related areas play a major role, such as detecting microbial threats in nurses. A second pathway refers to potentially altered brain functioning in olfactory disorders.

importance (Croy et al. 2011). Compared with hyposmic patients, anosmic patients stated that they try to use the sense of smell less often in daily life. Both groups rated their sense of smell as less important than a group of normosmic people. Interestingly, 13% of the patients expressed enhanced scores in an aggravation scale (e.g. “without the sense of smell my life would be worthless”), indicating that they exhibit major problems adjusting to the deficit. These patients also exhibited significantly higher depression scores. However, there seems to be only a small number of patients with major problems in coping with the impairment. That is probably why Frasnelli and Hummel (2005) found no general correlation between coping and depression.

Severity and duration of the olfactory impairment influencing QoL

In a study conducted by Simopoulos et al. (2012), a very high correlation ($r = -0.7$) was found between olfactory dysfunction and olfactory-related QoL in a group of 102 chronic rhinosinusitis patients with and without olfactory deficits. Furthermore, the more pronounced the olfactory disorder, the more symptoms of anxiety and depression were reported. However, inclusion of a group without impaired olfactory function is likely to overestimate the coherence. Among groups of patients with olfactory loss only, the correlation between olfactory impairment and olfactory-related QoL (Frasnelli and Hummel 2005; Neuland et al. 2011) and general QoL was rather low (Neuland et al. 2011). There are indications that general QoL is reduced more severely in hyposmic compared with anosmic patients (Neuland et al. 2011). The authors interpret this as enhanced hope for recovery in hyposmic patients, which may prevent attempts to cope with the disorder.

When asked specifically about several domains related to olfaction, disease duration showed no influence on daily life disturbance (Temmel et al. 2002; Neuland et al. 2011). However, adjustment over time can be seen when patients are asked in a different way. Decreased enjoyment of food is less pronounced when the disorder lasts more than 3 years (Ferris and Duffy 1989) and the number of household hazards decreases over the first 2 years (Bojanowski et al. 2013). Along the same line, Tennen et al. (1991) report that patients with longer disorder duration exhibit lower scores in the BDI. In accordance, patients with a disorder duration of more than 1 year tended to use their sense of olfaction less often than patients with shorter disorder duration, indicating adjustment (Croy et al. 2011). Shu et al. (2011) found a positive correlation between disorder duration and score on the Positive Statements subscale of the Questionnaire of Olfactory Disorders among their 413 patients, indicating that patients learn to cope with their olfactory loss.

Influence of age

Physiological anorexia is common in the older population and may—at least to some degree—be explained by olfactory loss, which also means loss of retronasal olfactory function affecting flavor perception. Data from older people with changes in olfactory perception also suggest a decrease in food appreciation and appetite, change in food choice such as decreased dietary variation, poor nutritional status, change in body weight, and an increased risk for chronic disease (Fanelli and Steinhagen 1985; Wysocki and Pelchat 1993; Mattes and Cowart 1994; Duffy et al. 1995; Griep et al. 1995; Morley 2001; Wilson and Morley 2003; Karpa et al. 2010). Rolls and McDermott have demonstrated that sensory-specific satiety is less pronounced in older people compared with young adults, which may explain the decreased dietary

variation with age (Rolls and McDermott 1991). However, not all studies have shown a relation between chemosensory impairment and nutritional problems (Ferris and Duffy 1989).

There may also be a considerable risk among older people to ingest spoiled food. It has, for example, been suggested that older adults are less likely than young adults to reject foods with unpleasant odors (Pelchat 2000). It is possible that this results in increased risk of minor gastrointestinal complaints, which is a common condition among elderly (Firth and Prather 2002). Importantly, Schiffman and collaborators have reported that anorexia in the older people often remits when foods are amplified by additional flavoring (e.g., artificial chicken flavor on a chicken dish) to compensate for diminished chemosensory function (Schiffman and Warwick 1988). More specifically, additional flavoring seems to increase institutionalized older peoples' preference for and intake of food (Schiffman 1998), increase salivation (Schiffman 1998; Schiffman and Miletic 1999), and improve immunological status and grip strength (Schiffman and Warwick 1993). However, more recently, these early findings have been discussed controversially (Koskinen et al. 2005; Kremer et al. 2007).

Boesveldt et al. (2011) observed a small correlation between olfactory function and depression in older persons. In a line, Seo et al. (2009) reported that olfactory disorders were significantly associated with low QoL and depression in older people and also with low cognitive function. However, the associations with QoL and depression did not remain when controlling for cognitive function. This illustrates the importance of controlling for incipient dementia when studying QoL and depression in older people with olfactory impairment. Olfactory impairment is an early sign of Alzheimer's disease (Nordin 2012) and Parkinson's disease (Ponsen et al. 2004), and poor QoL and depression are common in dementia (Hoe et al. 2006). Nevertheless, associations between olfactory impairment and poor QoL and depression have been reported even after controlling for loss in cognitive function among older people and are associated also with functional disability and reduced independence (Gopinath et al. 2012).

Final remarks

Olfaction plays an important role for ingestion, harm avoidance, and social communication. However, about one-fifth of the population exhibits smell disorders, and most of them are not aware of it. Those persons who seek medical treatment often have problems finding a physician who is familiar with smell disorders (Haxel et al. 2012). Almost exclusively, patients presenting to such specialized physicians or to smell and taste centers are included in studies about the consequences of olfactory loss. This means that the basic population of people with smell disorders is not represented equally but that there is a strong bias towards

patients with a certain psychological strain. This has to be kept in mind when we conclude that olfactory loss leads to disturbances in olfactory important areas, mainly in eating, detecting of harmful food and smoke, and to some extent, in social situations and working life. Most of the patients seem to cope well with these restrictions. However, about one-third of the patients with acquired and congenital olfactory disorders have more severe problems and express a noticeable reduction in QoL.

Funding

This work was supported by the Maria Reiche Scholarship from the technical University of Dresden to I.C.

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