Objective: To investigate the consequences of olfactory loss and explore specific questions related to the effect of duration of olfactory loss, degree of olfactory sensitivity, and cause of the olfactory loss.

Patients: A total of 278 consecutive patients with hyposmia or anosmia were examined.

Results: Causes of olfactory loss were categorized as follows: trauma (17%), upper respiratory tract infection (URI) (39%), sinonasal disease (21%), congenital anosmia (3%), idiopathic causes (18%), or other causes (3%). Our data suggest that (1) recovery rate was higher in URI olfactory loss than in olfactory loss from other causes; (2) likelihood of recovery seemed to decrease with increased duration of olfactory loss; and (3) the elderly are more prone to URI olfactory loss than younger patients. Regarding changes in quality of life (QoL), we found that (1) in most patients olfactory loss caused food-related problems; (2) loss in QoL did not change with duration of olfactory loss; (3) younger patients had more complaints than older ones, and women had more complaints than men; (4) complaint scores were higher in hyposmic patients than in anosmic patients; and (5) self-rated depression did not relate to measured olfactory function.

Conclusions: Among many complaints of olfactory loss, the predominant ones were food related. This loss in QoL seemed to be of greater importance in younger than in older people, and women seem to be affected more strongly than men.


LOSS OF olfactory function affects the patient’s appreciation of food and drink; it has an impact on safety (eg, detection of spoiled foods and smoke); and it may also produce bodily insecurity: the patient’s own body odors are no longer self-perceived, which, in our clinical experience and that of others, has led to an exaggeration of patients’ hygiene measures or the excessive use of perfume. However, the loss of olfaction can be particularly insidious and escape detection because, unlike loss of sight or hearing, it is not readily apparent to others. A good example of this difficulty of detection is that patients with congenital anosmia in our population did not discover their olfactory loss until after age 10 years. The present study was designed to investigate the consequences of olfactory loss in daily life and to explore specific questions related to the effect of the duration, degree, and causes of the olfactory disorder.
PATIENTS, MATERIALS, AND METHODS

We evaluated 278 consecutive patients (155 women, 123 men) with olfactory loss who were either referred or directly sought help for olfactory disorders at the departments of otorhinolaryngology of the University of Vienna, Austria, and the University of Dresden, Germany. Subjects were between ages 14 and 86 years. The study was performed according to the principles of the Declaration of Helsinki/Summerset West on biomedical research involving human subjects. All patients were thoroughly examined by an experienced otorhinolaryngologist, including detailed endoscopic investigation of the olfactory cleft. Whenever a patient’s history was unclear or the psychophysical olfactory test results were ambiguous, the patient additionally underwent computed tomographic scans of the nasal cavity, magnetic resonance imaging with a special focus on important olfactory structures (eg, olfactory bulbs and tracts, olfactory sulcus), or olfactory evoked potentials.

CHEMOSENSORY TESTING

Psychophysical testing was performed by means of “Snif-fin’ Sticks” bilaterally, and it involved tests for odor threshold (N-butanol), discrimination, and identification. Results of the 3 subtests were presented as a sum of the results obtained for threshold, discrimination, and identification measures (TDI score). If the TDI score was 31 or higher, the patient was considered normosmic; with a score between 16 and 30, he or she was considered hyposmic. With a score lower than 16, the patient was regarded as functionally anosmic. Of olfactory evaluation required approximately 30 minutes. Diagnostic criteria for the classification of the cause of the olfactory disorder are given in Table 1.

QUESTIONNAIRE

A self-reporting questionnaire was used that contained mainly questions regarding olfactory sensitivity and quality of life (QoL) issues. It had been developed in collaboration with the Arbeitsgemeinschaft Olfaktologie/Gustologie der Deutschen Gesellschaft für Hals-Nasen-Ohrenheilkunde, Kopf- und Halschirurgie, Dresden, Germany. Questions related to the subjective degree of olfactory loss and associated difficulties such as cooking, eating, body hygiene, appetite, problems in everyday life, ways to manage this handicap, and the subjective degree of decrease of QoL. Both affirmative and symptom-based questions were used. Questionnaires were filled in before commencement of olfactory tests. After receiving detailed instructions by a member of the staff, the subjects usually completed the forms in the waiting area.

STATISTICAL ANALYSIS

Statistical analyses were performed using SPSS 10.0 (SPSS Inc, Chicago, Ill). Data were submitted to nonparametric statistical analysis including Kruskal-Wallis, Mann-Whitney, and chi-squared tests. Correlational analyses were performed using Spearman statistics. The minimum p value was .05. Nonsignificant results are indicated as NS.

these patients who were older than 70 years, aging might have contributed to olfactory loss.

RELATIONSHIP OF TEST SCORES TO CAUSES OF OLFACTORY LOSS

Results of the 3 different olfactory tests are shown in Table 2, separately for anosmic and hyposmic patients in relation to the investigated causes of olfactory loss. When comparing results of hyposmic patients in the 3 olfactory tests, we found no significant difference between the 4 major causes ($\chi^2 < 2.3; P > .51$; Kruskal-Wallis test); in other words, the results pattern from the 3 olfactory tests did not indicate the cause of the disorder.

In URI olfactory loss, more patients were found to be hyposmic (n=62) than anosmic (n=40) ($\chi^2 = 4.75; P = .03$). In contrast, for all other causes, this ratio was reversed (for SND, 28 hyposmic vs 32 anosmic [NS]; trauma, 15 hyposmic vs 32 anosmic [$\chi^2 = 6.15; P = .01$]; idiopathic cases, 18 hyposmic vs 33 anosmic [$\chi^2 = 4.41; P = .04$]; other causes, 4 hyposmic vs 5 anosmic [NS]).

RELATIONSHIP BETWEEN SEX AND OLFACTORY DISORDER

A higher percentage of women (44%) than men (28%) suffered from URI olfactory loss ($\chi^2 = 11.3; P = .001$). These sex-related differences were not significant for SND (19% women vs 25% men), trauma-related olfactory loss (12% women vs 24% men), or idiopathic olfactory disorders (19% women vs 18% men). Approximately the same portion of male and female patients suffered from hyposmia and anosmia (women, 73 with hyposmia vs 82 with anosmia; men, 54 with hyposmia vs 69 with anosmia).

RELATIONSHIP BETWEEN AGE AND OLFACTORY DISORDER

We categorized subjects into 3 age groups: group A, younger than 41 years (n=60); group B, 41-60 years (n=130); and group C, older than 60 years (n=88). Different causes were present at different ratios in these 3 age groups. The highest percentage of URI olfactory disorders was seen in older subjects (group A, 23%; group B, 31%; and group C, 55%). No such differences were found for SND (A, 30%; B, 24%; and C, 13%), posttraumatic causes (A, 20%; B, 18%; and C, 14%), or idiopathic causes (group A, 15%; B, 22%; and C, 15%) (Figure 2). Statistical differences in the relative presence of the 4 most frequent causes were found only for group C ($\chi^2 = 46.38; P < .001$). The relative number of hyposmic patients was not significantly different in different age groups (group A, 31 hyposmic vs 29 anosmic; group B, 56 hyposmic vs 74 anosmic; group C, 40 hyposmic vs 48 anosmic).
We categorized subjects into 3 duration groups of olfactory loss: group A, less than 24 months; group B, 24-48 months; and group C, longer than 48 months. The presence of anosmia increased with duration of olfactory loss. Specifically, most of the patients with the longest duration of olfactory loss were anosmic (group C, 16 hyposmic vs 34 anosmic; χ²=6.48; P = .01); no significant differences were found between the frequencies of hyposmia and anosmia in group A (55 hyposmic vs 53 anosmic) or B (25 hyposmic vs 21 anosmic). In addition, the percentage of patients with different causes of olfactory disorders was associated with the duration of the disease. That is, URI olfactory disorders were most frequent in duration groups A (56%) and B (57%) and least frequent in group C (26%). The percentage of SND increased with increasing duration (group A, 5%; B, 9%; and C, 24%); similar findings were made for idiopathic olfactory loss (group A, 14%; B, 4%; and C, 30%) but not for trauma (group A, 22%; B, 26%; and C, 16%) or other causes (group A, 4%; B, 4%; and C, 4%). Accordingly, statistics revealed that the percentages of the most frequent causes were significantly different when the duration of disease was shorter than 48 months (group A, χ²=66.2 with P<.001; group B, χ²=32.3 with P<.001), but not when the duration of disease was longer than 48 months.

The percentage of women was found to be higher in duration group A (64% women vs 36% men; χ²=8.33; P=.004). In duration groups B and C, men and women were more equally distributed (group B, 44 women vs 57 men; group C, 46 women vs 54 men; NS).

### SELF-RATINGS OF OLFACTOR Y AND GUSTATORY FUNCTION

Most of the examined patients fully completed the questionnaire. From a total of 275 patients, 210 (76%) reported loss of olfactory sensitivity and 210 patients (76%) reported altered sensitivity. Interestingly, although 11 (4%) of the 275 patients reported normal olfactory sensitivity, after testing 5 of these 11 were diagnosed as functionally anosmic, and the remaining 6 as hyposmic. These patients had been referred to the clinic by other otorhinolaryngologists or by general practitioners who suspected olfactory loss; some of them also came because relatives and/or spouses urged them to seek counseling.

### RELATIONSHIP BETWEEN DURATION OF OLFACTOR Y DISORDER, CAUSE, AGE, AND SEX

On average, patients reported a 20% decrease of QoL related to their olfactory loss. These figures differed with causes: patients with URI olfactory disorders (22%), SND (27%), trauma (19%), idiopathic causes (13%), or other causes (13%) rated the loss of QoL to a similar degree (differences NS). Patients with congenital anosmia indicated no loss (0%) in QoL. No significant difference in QoL was found across age groups, indicating that decreased QoL was not correlated with the duration of olfactory loss. Similarly, neither sex-related (women, 21% vs men, 19%) nor age-related differences (age group A, 24%; B, 21%; and C, 15%) were seen in this measure of QoL. In hyposmic patients, the self-rated decrease of QoL exhibited a low coefficient of correlation with the subject's olfactory loss as measured by the TDI score (r=0.22; P=.02).

### DIFFICULTIES IN DAILY LIFE

Almost all patients reported difficulties in daily life due to their olfactory disorders. Specifically, 73% complained of difficulties with cooking, 68% of mood changes, 56% of decreased appetite, 50% of eating spoiled food, 41% of too little perception of their own body odor, 30% of burning food, and 8% of problems at work (Figure 3).
These complaints were added to create a complaint score (percentage of complaints present); i.e., presence of an individual complaint was valued as “1”; absence of this complaint, “0.” The maximum complaint score (all complaints present) was 100%; the lowest score (no complaints) was 0%.

Both age and sex had a significant effect on difficulties in daily life. Specifically, the youngest patients had the highest degree of difficulties (age group A, 54%; B, 53%; C, 38% \( \chi^2 = 24.6; P<.001 \); Kruskal-Wallis test) (Figure 4), and women mentioned more complaints than men (53% vs 42%, respectively; \( U=6751; P<.001 \); Mann-Whitney test) (Figure 4). Duration of disease had no significant effect on the complaint score (duration group A, 46%; B, 43%; and C, 46%). Similarly, the cause of the olfactory disorder had no significant effect (URI, 46%; SND, 53%; trauma, 47%; and idiopathic causes, 51%).

Anosmic patients had a lower complaint score than hyposmic ones (anosmia, 45%; hyposmia, 52%; \( U=7881; P = .01 \); Mann-Whitney test) (Figure 4); however, there was no significant difference between anosmia and hyposmia in QoL ratings (subjects with anosmia, 16%; subjects with hyposmia, 24%). In hyposmic patients, no significant correlation was found between the complaint score and the patient’s ability to smell (TDI score). In addition, the complaint score and the self-rated QoL did not correlate very well (\( r^2=.18; P = .01 \)).

Patients who reported depressed mood as a consequence of olfactory loss had significantly higher complaint scores (depressed, 66%; nondepressed, 45%; \( U=964; P < .001 \); Mann-Whitney test) and higher self-ratings of loss of QoL (depressed, 44%; nondepressed, 29%; \( U=1824; P = .001 \); Mann-Whitney test). In contrast, there was no significant difference between these 2 groups of patients regarding self-rated olfactory abilities (depressed, 22%; nondepressed, 22%) and TDI score (depressed, 16.2; nondepressed, 16.4).

**COMMENT**

The present study addresses 2 major issues: (1) specific characteristics of olfactory disorders as related to their causes and (2) the effects of olfactory disorders on daily life. Herein we discuss some of our more important findings.

**DIFFERENT OLFACTORY SUBTESTS DO NOT SEEM TO DIFFERENTIATE BETWEEN CAUSES OF OLFACTORY LOSS**

The present data indicate that causes of olfactory loss have no significant influence on results in odor thresh-
olds, discrimination, and identification. However, further research in larger populations is needed to investigate whether the 3 tests of olfactory function differ in their sensitivity to olfactory deficits in different age groups or in relation to the duration of the olfactory loss.

PATIENTS MAY REPORT NORMAL Olfactory FUNCTION IN THE PRESENCE OF ANOSMIA

In the present study, 4% of the patients reported normal olfactory function despite the presence of olfactory deficit. This indicates once more that olfactory testing is needed to properly evaluate patients’ olfactory abilities. Recently, it has also been reported that 42% of 203 patients were unable to correctly rate olfactory loss on a 4-point scale (normal, impaired but not absent, no ability, highly sensitive). Thus, it seems that a simple interview may provide entirely misleading information.

INDICATIONS FOR HIGHER RECOVERY RATE IN URI Olfactory LOSS

Among patients with URI olfactory loss, hyposmia was more common than anosmia. In addition, duration of olfactory loss was found to be shorter in URI olfactory disorders than in SND-related or idiopathic olfactory dysfunction. These findings may relate to the relatively high rate of recovery found in URI disorders.

LIKELIHOOD OF RECOVERY DECREASES WITH INCREASING DURATION OF Olfactory LOSS

The presence of anosmia was found to increase as the duration of the olfactory loss increased. This is consistent with reports that late recovery is relatively rare.

ELDERLY PATIENTS ARE PRONE TO URI Olfactory LOSS

Consistent with other observations, we found that URI olfactory loss was more frequent in patients 65 years or older, whereas all other causes were almost equally distributed across the ages. In addition, an age-related increase in the prevalence of olfactory loss has been reported. The same study indicated that olfactory dysfunction due to influenza and/or common colds and/or sinus infection correlated negatively with age. Because the authors evaluated olfactory loss in the context of URI and SND, this specific finding neither supports nor contradicts the present observations. This higher incidence of URI olfactory loss in elderly persons may relate to the age-related decrease of the size of the olfactory epithelium, and thus to a higher vulnerability to the consequences of the infection.

DECREASE IN QoL MAY RELATE TO THE DEGREE OF Olfactory FUNCTION BEFORE LOSS OF Olfactory ABILITIES

More than 70% of our population reported that the chemosensory disorder interfered with their daily life activities, including food preparation and intake. Both age and

Figure 3. Quality of life issues of patients with olfactory loss: cooking indicates difficulties with cooking; mood, mood changes; appetite, decreased appetite; spoiled food, eating of spoiled food because of inability to smell spoilage; body odor, too little perception of own body odor; burnt food, burning food while cooking because of inability to detect burning odor; and work, work-related problems.

Figure 4. In the comparison of complaint scores in relation to age, sex, and olfactory loss, the oldest patients had the lowest number of difficulties (P<.001); women mentioned more complaints than men (P<.001); and anosmic patients had lower scores than hyposmic ones (P<.01).
sex had a significant effect on difficulties in daily life. Specifically, younger patients had more complaints than older ones, and women had more than men. This may relate to the relative loss of olfactory function, or, in other words, to the degree of olfactory function before its loss. Specifically, as olfactory function is best in the young and better in women than in men, these initially more sensitive groups are more likely to have the most complaints when olfactory function is impaired. The higher significance of olfactory loss in relation to sex may also be a factor in the shorter duration of olfactory loss in women than in men. That is, women seem to find olfactory problems more disturbing and thus may seek counseling sooner than men.

In terms of self-reported changes of quality of life, 42% of our population indicated a decrease in QoL of more than 10%. In comparison, it has been reported that 82% of subjects with hearing loss indicated a decreased QoL. 24% of patients with hearing loss were reported to be depressed. In this context it should also be mentioned that our population is certainly nonrepresentative of all people with olfactory loss. Most of our patients report a high olfactory sensitivity prior to loss of olfactory function. Thus, it may well be that patients with a lower degree of olfactory acuity prior to loss may not even seek counseling.

DECREASE OF QoL DOES NOT CHANGE WITH DURATION OF OLFACTORY LOSS

Duration of olfactory loss did not seem to affect self-rated changes in QoL. This finding emphasizes the significance of smells for everyday life; it also indicates that various coping strategies may be insufficient to deal with this loss of olfactory-mediated sensations. 22

COMPLAINT SCORES SEEM TO BE HIGHER IN HYPOSMIA THAN IN ANOSMIA

In the present study, hyposmic patients had higher complaint scores than anosmic patients. What would explain this anomalous finding? One explanation may relate to the reinforcing character of the occasional perception of odors in hyposmia. It may serve as a constant reminder of the loss of flavor as a loss of taste and thus confuse the relatively small financial compensation of olfactory loss in legal cases, one must not forget specific professions that strongly rely on an intact sense of smell (eg, perfumers or chefs).

SELF-RATED DEPRESSION SEEMINGLY DOES NOT RELATE TO MEASURED OLFACTORY FUNCTION

Patients reporting to be depressed had higher complaint scores and higher self-reported loss of QoL, but did not differ in terms of their TDI scores. Here, it seems possible that the difference between olfactory sensitivity prior and after the loss of olfactory function might be the decisive factor in this correlation. In other words, the relative loss of olfactory function may relate to the development of a depressive state. 24, 25

Lifetime prevalence for any psychiatric morbidity ranges from 21% to 65%, and depression is among the most common. It has been reported that 28% of patients with olfactory dysfunction have a feeling of vulnerability because they have difficulties detecting spoiled foods, smoke, gas, or body odors. 22 As many as 26% of patients with olfactory dysfunction even reported disruption of their marital, sexual, and social relationships in relation to their olfactory loss. 22 In addition, in a study using the Beck Depression Inventory and the revised symptom checklist 90, at least 17% of patients with olfactory loss suffered from moderate depression. 22

OLFACTORY LOSS SEEMS TO PRODUCE FEW WORK-RELATED PROBLEMS

A relatively small number of patients indicated that problems of olfaction interfered with their occupations. This might be because (1) older patients were usually retired, and (2) our population did not include many patients professionally involved in the analysis of odors (eg, the food or chemical industries). On the other hand, one would like to think that, for example, electricians would need to know when and where cables burn or car mechanics would need to know whether this clear liquid was water or gasoline. 22 While the present observations may be used as an argument in the discussion regarding the relatively small financial compensation of olfactory loss in legal cases, one must not forget specific professions that strongly rely on an intact sense of smell (eg, perfumers or chefs).

OLFACTORY LOSS SEEMS TO PRODUCE MOSTLY FOOD-RELATED PROBLEMS

Food preparation and intake was a major problem in our population. Flavor is a complex interaction of smell, taste, pH, temperature, texture, and sensitivity of the oral cavity. However, patients often associate flavor with the sense of taste only. Most patients with olfactory loss experience the loss of flavor as a loss of taste and thus confuse olfactory and gustatory abilities. 6 Some authors provide evidence olfactory dysfunction does not lead to nutritional problems. 26 When interviewed about food preferences, only 24% of anosmic patients reported unchanged preferences. 27 Many anosmic patients also reported that they forget about the need to eat. Others reported weight loss (7%); still others reported weight gain (14%). 28 This is consistent with our own experiences with anosmic patients who complain of weight gain; that is, after having lost the most sophisticated sense to enjoy foods, some patients with anosmia simply eat more sweet dishes to reward themselves after an uninteresting dinner.

Olfactory loss produces numerous complaints. It severely affects the lives of patients who report to special-
ized centers. This clearly indicates the need for an increased research effort in the treatment of olfactory loss.

Accepted for publication November 16, 2001.

We thank Kati Rosenheim and S. Pabinger for their help in acquisition of the data; Ebba Héden-Blomqvist, MD, for her thoughtful comments on the manuscript; and Elisabeth Pauli, PhD, for her help with the statistical analysis of this investigation.

Corresponding author: Thomas Hummel, MD, Department of Otorhinolaryngology, University of Dresden Medical School, Fetscherstr 74, 01307 Dresden, Germany (e-mail: thummel@rcs.urz.tu-dresden.de).

REFERENCES