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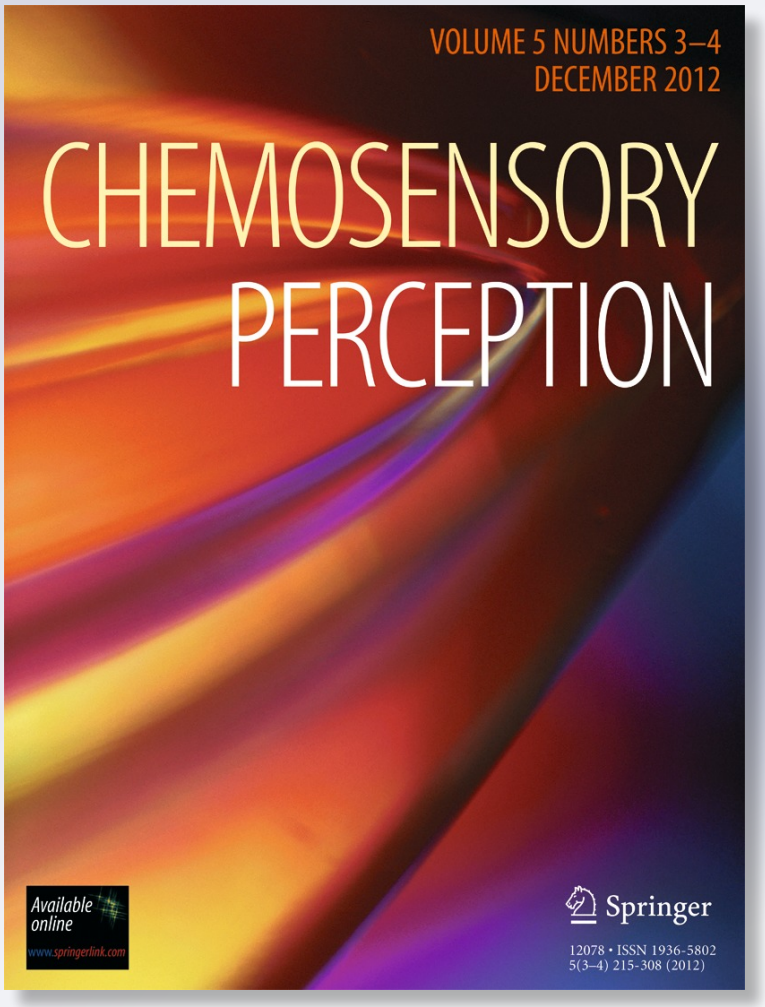

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Development of a Brief Self-Report Inventory to Measure Olfactory Dysfunction and Quality of Life in Patients with Problems with the Sense of Smell

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Abstract Large population-based studies using validated olfactory tests have shown that about 20 % of individuals aged 20 to 90 years have impaired olfactory function. The goal of the present study was the development of an easy to administer and reliable questionnaire to assess self-reported olfactory functioning in patients suffering from problems with the sense of smell. A cross-sectional, psychometric study using factor analysis and internal consistency methodology was performed to develop the 12-item questionnaire for the assessment of self-reported olfactory functioning and olfaction-related quality of life (ASOF). Discriminative validity of the three ASOF scales was assessed by comparing healthy controls and patients with problems with the sense of smell. Three hundred and thirteen normal controls with intact olfaction and 35 patients with olfactory dysfunction were included. All subjects included in the study were evaluated for olfactory dysfunction by means of the Sniffin' Sticks. The ASOF can be subdivided into three domains: the one-item subjective olfactory capability scale (SOC), the five-item self-reported capability of perceiving specific odors scale (SRP), and the six-item olfactory-related quality of life (ORQ) scale. All three scales discriminated significantly between healthy controls and patients. The ASOF measures subjective olfactory functioning reliably and consistently, in normosmic subjects as well as in patients with olfactory dysfunction. The ASOF is a clinically relevant and practical diagnostic tool with very good psychometric properties. This new questionnaire may be helpful in the comprehensive evaluation of patients with olfactory disorders.

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Introduction

Large population-based studies using validated olfactory tests have shown that about 20 % of individuals aged 20 to 90 years have impaired olfactory function (Murphy et al. 2002; Bramerson et al. 2004). The 5-year incidence of olfactory impairment in older adults (age range from 53 to 91 years) is about 12 % (Schubert et al. 2011). The sense of smell is closely connected to important biological functions such as eating, drinking, mating, and avoidance of danger. As a consequence, patients with olfactory dysfunction report difficulties in daily living due to an olfactory disorder (Hoffman et al. 1998). The loss of the sense of smell has a significant impact on patients' lives. In a cohort of 280 patients with severe hyposmia or anosmia, health-related quality of life was severely impaired (Landis et al. 2004). In a previous retrospective study of 750 patients tested in a smell research center, patients reported reduced body weight, appetite, and psychological well-being and had higher scores on a depression inventory (Deems et al. 1991). Among 278 patients with olfactory dysfunction, 73 % complained of difficulties in cooking, 68 % experienced mood changes, 56 % a decreased appetite, 50 % ate rotten food, 41 % had too little perception of their own body odor, 30 % burned food, and 8 % had problems at work (Temmel et al. 2002). Another study on 345 patients with olfactory dysfunction found similar figures. Seventy-five percent of these patients had problems in detecting spoiled food, 61 % in detecting gas leaks, and 50 % in detecting smoke. Additionally, 53 % of the patients showed reduced ability in cooking and 53 % in eating (Miwa et al. 2001).

There has long been a need for psychometric tools with established validity and reliability that measure the impact of olfactory dysfunction on daily life in patients reporting smell problems. Several olfaction-specific assessment tools covering the impact of olfactory dysfunction on daily life have previously been developed. Each of them covers a specific aspect of impaired functional status and quality of life following olfactory dysfunction.

One early questionnaire is the Present Odor Perception Scale (POPS) (de Jong et al. 1999). This scale consists of three questions that indicate how well the patient thinks he or she can smell. Such a unitary scale, however, does not cover the full range of problems reported by patients with olfactory dysfunction. Another measure is the Questionnaire for Olfactory Dysfunction (QOD) (Croy et al. 2011), which consists of 19 statements on life quality, six statements on sincerity (giving socially desired answers), and four statements concerning parosmia. Another measure is the Importance of Olfaction Questionnaire (IO) (Neuland et al. 2011). The scale estimates the individual significance of olfactory function and also investigates adjustment processes in daily use of the sense of smell. It covers three main areas: association, application, and consequence.The association scale concerns the emotions, memories, and evaluations that are triggered by the sense of smell. The application scale measures to what extent a subject uses his or her sense of smell in daily life, that is, how subjects differ in the intentional application of smelling behavior in different situations. The consequence scale focuses on the conclusions subjects draw from their olfactory impressions and the importance attributed to the sense of smell in daily decisions.

Over the last 30 years, progress has been made in understanding olfactory disorders, and several olfactory tests have been commercially available to objectively evaluate olfactory dysfunction. The most popular of these tests are the University of Pennsylvania Smell Identification Test (UPSIT) (Doty et al. 1984) and the Sniffin' Sticks Test (Kobal et al. 1996). Because there is only a moderate correlation between subjective ratings and objective measures of olfactory function (Bahar-Fuchs et al. 2011; Marschner et al. 2010), it is also important to obtain independent information about the subjective impact of smell-related problems in patients with olfactory dysfunction in order to optimize treatment.

Thus, it was our goal to develop a questionnaire that assesses a wide range of problems patients with olfactory dysfunction have to deal with and which complements and goes beyond existing measures. The assessment included self-reported general olfactory capability, self-reported capability of perceiving specific odors, and self-reported olfaction-related quality of life in patients with olfactory dysfunction. The questionnaire was designed for use in normal subjects and patients with olfactory dysfunction and, above all, for easy administration without compromising psychometric properties. We hypothesized that patients with olfactory dysfunction would show reduced self-reported general olfactory capability, reduced self-reported capability of perceiving specific odors, and reduced self-reported olfaction-related quality of life, in comparison with healthy control subjects.

Material and Methods

Our goal was to design and validate a self-administered questionnaire that measures self-reported olfactory functioning and self-reported olfaction-related quality of life. A cross-sectional study design was chosen that included healthy controls and patients with olfactory dysfunction. The procedures followed were in accordance with the Helsinki Declaration of the World Medical Association. All statistical procedures were performed using computerized statistical software (SPSS). The significance level was set at $p=0.05$.

Development of the Survey Questionnaire

Participants

In an initial step, the questionnaire was pilot tested on a group of 20 patients (10 M: 10 F; age range 18–60 years, mean age 45.1 ± 8.0 years), with olfactory dysfunction from the Neurological Clinic to evaluate survey comprehension, content, and clarity. Thirty medical students without olfactory complaints (15 M: 15 F; age range 18–30 years, mean age 23.1 ± 2.0 years), also assessed their olfactory functioning by means of the questionnaire.

Materials

After a review of the relevant literature concerning olfactory disorders and interviewing patients with olfactory dysfunction, initial topics were selected for the questionnaire. Three domains emerged: (a) self-reported general olfactory capability, (b) subjective problems in perceiving specific odors, and (c) loss of quality of life due to impaired olfaction.

Results

Content and face validity were confirmed with patient piloting and interviews. Reliability was established by calculating internal consistency (Cronbach α coefficient) and item selectivity (item to total score correlation) from medical students. The reliability measures were

used to determine item reduction (Lienert 1989; Bortz 1993). The initial survey questionnaire included 14 items with three smell domains: the one-item subjective olfactory capability (SOC) domain, the seven-item problems in perceiving specific odors domain, and the six-item impairment of quality of life due to loss of the sense of smell domain. The seven-item "problems in perceiving specific odors" domain had an overall α coefficient of 0.76. In order to improve internal consistency, two items were omitted due to low item selectivity. Item selectivity (item to total score correlation) for these two items were 0.17 and 0.07, respectively. For the remaining questions, item selectivity was above 0.46 for all items. Omitted items were (i) "How often does it happen that other people smell something you do not smell?—Never (5), Rarely (4), Sometimes (3), Often (2), Very often (1)", and (ii) "Compared to last year, how would you rate your current sense of smell?—Much better (5), Better (4), The same (3), Worse (2), Much worse (1)." After item reduction, the α coefficient increased to 0.87. The olfactory-related quality of life domain included six items and yielded a Cronbach α coefficient of 0.91. As item selectivity was satisfactory (>0.60) for all questions, this part of the questionnaire remained unchanged. In summary, the final design of the 12-item questionnaire for the assessment of self-reported olfactory functioning and olfaction-related quality of life (ASOF) was reached after statistical item reduction. It included the one-item SOC, the five-item self-reported smell-related problems scale (SRP), and the six-item olfactory-related quality of life (ORQ) scale (see Table 1 for all item questions).

Normative Sampling Procedure

Participants

Three hundred and thirteen healthy controls (118 M: 195 F; age range 18–82 years, mean age 57.1 ± 16.0 years) who had been screened for intact olfaction (Sniffin' Sticks identification score of 10 or greater) and intact cognition were included in the study.

Procedure

In the next step, the ASOF questionnaire was given to healthy controls in order to investigate internal consistency and item selectivity, questionnaire structure (factor analysis), scale intercorrelations, relationship to demographic variables age and sex, convergent validity, and cutoff scores for impaired subjective olfactory functioning in a healthy control sample without olfactory dysfunction. The scale was administered by means of pencil and paper, and it took the participants approximately 5 min to perform the ASOF questionnaire. Scoring of the ASOF questionnaire generally took 2 min.

Participants were also tested with the Sniffin' Sticks identification test for the assessment of olfactory function. This test uses a multiple choice form of assessment to evaluate odor identification ability and can be administered within 10 min. The Sniffin' Sticks was always administered after the ASOF. The Identification Test of the Sniffin' Sticks has been shown to be highly sensitive to age-related odor identification decline and additionally very useful in clinical use because it is easy to administer and score. Thus, the Identification Test of the Sniffin' Sticks is a suitable clinical test for the assessment of olfactory functions. Adequate normative data are available for healthy controls. In order to control for transient olfactory dysfunction due to an actual common cold, all healthy subjects were screened in an interview. No subject reporting a common cold at the time of examination was included in the study.

Results

Internal Consistency and Item Selectivity of the ASOF Using the raw scores of healthy subjects, internal consistency and item selectivity was calculated. Cronbach α was 0.87 for the SRP scale and 0.89 for the ORQ scale, respectively. Item to total score correlation ranged from 0.62 to 0.78 for single questions of the SRP scale and from 0.60 to 0.77 for single questions of the ORQ scale. See Table 2 for details.

Factor Analysis of the ASOF A confirmatory factor analysis with varimax transformation using the raw scores of healthy controls revealed three factors with eigenvalues higher than 1, explaining 71.6 % of the variance. Factor 1 (eigenvalue 5.26) included questions ORG-1 to ORQ-6, factor 2 (eigenvalue 2.24) included questions SRP-1 to SRP-5, and factor 3 (eigenvalue 1.08) included question SOC. Individual item eigenvalues are listed in Table 3.

Scale Intercorrelations of the ASOF Scale intercorrelations for healthy controls were calculated using Pearson's correlation coefficient. All coefficients were statistically significant. The correlation coefficient for SOC and ORQ was 0.42 (p=0.001), the correlation coefficient for SRP and ORQ was 0.45 (p=0.001), and the correlation coefficient for SOC and SRP was 0.37 (p=0.001).

Relationship of the ASOF Scales to the Demographic Variables Age and Sex in Healthy Controls Correlational analyses revealed that SOC (r=−0.05, p=0.09), SRP (r=−0.08, p=0.14), and ORQ (r=−0.08, p=0.12) were not significantly related to age. Statistical analyses using t tests

Table 1 12-item validated questionnaire for the assessment of self-reported olfactory functioning and olfaction-related quality of life (ASOF)

Assessment of self-reported olfactory functioning and

olfaction related quality of life (ASOF)

Time Intervall 4 weeks

Name/ID:

Age:

Date:

Education:

Here are a few questions regarding your sense of smell. Please answer each question by selecting the appropriate digit (1,2,3….). If you are not sure how to answer the question, give your best possible answer and make a remark on the left side of the page. Please do not hesitate to ask for support if you need help reading or filling in the questionnaire. If you did not come across a specific odor during the past four weeks, please indicate whether you would have had problems having had contact with that odor.

How would you rate your sense of smell over the past four weeks?

SOC: Circle one number on a scale from 10 (best possible) to 0 (worst possible - unable to smell):

Best possible 10-–—9—-8—7—6—5—4—3-—2—1-—0 unable to smell

During the past four weeks, how often have you had problems

SRP-1... smelling the odor of spoiled food?

Very often (1) Often (2) Sometimes (3) Rarely (4) Never (5)

SRP-2... perceiving your body odor?

Very often (1) Often (2) Sometimes (3) Rarely (4) Never (5)

SRP-3... perceiving unpleasant ambient odors (e.g. smoke, gas)?

Very often (1) Often (2) Sometimes (3) Rarely (4) Never (5)

SRP-4... perceiving the body odor of women?

Very often (1) Often (2) Sometimes (3) Rarely (4) Never (5)

SRP-5... perceiving the body odor of men?

Very often (1) Often (2) Sometimes (3) Rarely (4) Never (5)

Table 1 (continued)

Have you been impaired over the past four weeks in the following areas, due to the functioning of your sense of smell? If so, to what extent?
ORQ-1... cooking
Very much impaired (1) fairly impaired (2) Moderately impaired (3) Slightly impaired (2) not at all impaired (5)
ORQ-2... sexual life
Very much impaired (1) fairly impaired (2) Moderately impaired (3) Slightly impaired (2) not at all impaired (5)
ORQ-3... eating food
Very much impaired (1) fairly impaired (2) Moderately impaired (3) Slightly impaired (2) not at all impaired (5)
ORQ-4... drinking beverages
Very much impaired (1) fairly impaired (2) Moderately impaired (3) Slightly impaired (2) not at all impaired (5)
ORQ-5... using perfumes, deodorants, etc.
Very much impaired (1) fairly impaired (2) Moderately impaired (3) Slightly impaired (2) not at all impaired (5)
ORQ-6... perceiving the scent of flowers
Very much impaired (1) fairly impaired (2) Moderately impaired (3) Slightly impaired (2) not at all impaired (5)

Self-reported general olfactory capability	SOC=	
Self-reported capability of perceiving specific odors	(SRP-1 + SRP-2 + SRP-3 + SRP-4+ SRP-5) / 5 =	
Self-reported olfaction-related quality of life	(ORQ-1 + ORQ-2 + ORQ-3 + ORQ-4 + ORQ-5 + ORQ-6) / 6 =	

detected no significant effects of sex for the SOC scale (mean male score 7.47 ± 2.15, mean female score 7.82 ± 1.97; t=−1.46, df=311, p=0.14), for the SRP scale (mean male score 4.49 ± 0.81, mean female score 4.55 ± 0.78; t=−0.72, df=311, p=0.48), or for the ORQ scale (mean male score 4.74 ± 0.59, mean female score 4.86 ± 0.46; t=−2.01, df=201.6, p=0.06).

Convergent Validity

Convergent validity was examined via correlation of the ASOF to objective olfactory testing (Identification Test of the Sniffin' Sticks) using healthy controls' data. The correlations between scores on the Identification Test of the Sniffin' Sticks and the ASOF scales were significant, although rather low (SOC r=0.14, p=0.011; SRP r=0.13, p=0.027; ORQ r=0.13, p=0.023).

ASOF Cutoff Scores for Impaired Subjective Olfactory Functioning

We proceeded to calculate cutoff scores for the three scales. For each scale, two standard deviations were subtracted from the mean values of healthy controls. Raw scores, two standard deviations below the mean of healthy controls, were defined as indicative of impaired subjective olfaction. Thus, patients were considered to have abnormal olfactory capabilities if the SOC score was equal to or less than 3. Patients were considered to have problems smelling odors if the SRP score was equal to or less than 2.9. Patients were

Table 2 Item selectivity (item to total score correlation) for the questionnaire for the assessment of self-reported olfactory functioning and olfaction-related quality of life (ASOF) for healthy controls and patients with olfactory dysfunction

	Item to total score correlation	
Item	Healthy controls	Patients
SOC-1	–	–
SRP-1	0.64	0.97
SRP-2	0.63	0.90
SRP-3	0.71	0.34
SRP-4	0.70	0.93
SRP-5	0.78	0.93
ORQ-1	0.77	0.91
ORQ-2	0.60	0.74
ORQ-3	0.71	0.94
ORQ-4	0.77	0.90
ORQ-5	0.73	0.78
ORQ-6	0.70	0.75

considered to have smell-related problems in quality of life if the ORQ score was equal to or less than 3.7.

ASOF and Patients with Olfactory Dysfunction

Patients

Thirty-five patients with olfactory dysfunction due to several different causes (posttraumatic, postviral, and idiopathic) who came to the Neurological Clinic for assessment of their olfactory dysfunction were included (22 M: 13 F; age range 19–81 years, mean age 55.2 ± 19.0 years). Patients underwent a complete neuropsychological examination and, in selected cases, a cranial MRI scan. Some patients were also seen by an ENT specialist. In order to control for transient olfactory dysfunction due to an actual common cold, all subjects were screened in an interview. No subject reporting a common cold at the time of examination was included in the study. The Identification Test of the Sniffin' Sticks was used for the assessment of olfactory dysfunction. All patients showed impaired olfactory identification.The mean score for the Sniffin' Sticks test for patients was 6.8 ± 2.2.

Procedure

The ASOF questionnaire was given to patients with olfactory dysfunction in order to investigate internal consistency and item selectivity, scale intercorrelations, relationship to demographic variables age and sex, convergent validity, and cutoff scores for impaired subjective olfactory functioning.

Results

Reliability and Validity of the ASOF in Patients with Olfactory Dysfunction Internal consistency for the reports of patients with olfactory dysfunction using Cronbach α was 0.93 for the SRP scale and 0.95 for the ORQ scale. Scale intercorrelations were calculated. Item to total score correlation ranged from 0.62 to 0.78 for single questions of the SRP scale and from 0.34 to 0.97 for single questions of the ORQ scale. See Table 2 for details.

We also calculated scale intercorrelations for patients with olfactory dysfunction. Pearson's correlation coefficient for SOC and ORQ was 0.56 (p=0.001), the correlation coefficient for SRP and ORQ was 0.55 (p=0.001), and the correlation coefficient for SOC and SRP was 0.62 (p=0.001).

Validity of the ASOF was assessed using discriminant and convergent techniques. The first approach was to determine the ASOF's discriminative power by comparing ASOF score profiles between healthy controls and patients with olfactory dysfunction. All three scales significantly discriminated between patients with olfactory dysfunction and healthy controls (see Table 4).

Relationship of the ASOF scales to the demographic variables age and sex in patients with olfactory dysfunction was also investigated. Correlational analyses revealed that

Table 3 Item eigenvalues for the questionnaire for the assessment of self-reported olfactory functioning and olfaction-related quality of life (ASOF)

Item	Factor 1	Factor 2	Factor 3
ORQ-4	**0.886**	0.113	−0.036
ORQ-1	**0.791**	0.185	0.169
ORQ-3	**0.786**	0.230	0.105
ORQ-2	**0.760**	0.048	−0.076
ORQ-5	**0.747**	0.168	0.311
ORQ-6	**0.735**	0.214	0.358
SRP-3	0.170	**0.822**	0.164
SRP-5	0.285	**0.809**	−0.321
SRP-1	0.110	**0.788**	0.131
SRP-2	0.032	**0.783**	0.337
SRP-4	0.275	**0.757**	−0.390
SOC	0.307	0.068	**0.772**

Items in bold belong to one factor

Table 4 Mean scores and standard deviation of healthy controls and patients with olfactory dysfunction for the three scales of the questionnaire for the assessment of self-reported olfactory functioning and olfaction-related quality of life (ASOF)

ASOF scales	Healthy controls (N=313)	Patients (N=35)	p value (t test)
SOC	7.68 ± 2.04	1.83 ± 1.69	p<0.001
SRP	4.53 ± 0.80	2.01 ± 1.04	p<0.001
ORG	4.81 ± 0.52	2.54 ± 1.20	p<0.001

SOC olfactory capability scale, *SRP* smell-related problems scale, *ORQ* olfactory-related quality of life scale

SOC (r=0.06, p=0.75), SRP (r=0.19, p=0.30), and ORQ (r=−0.11, p=0.55) were not significantly related to age. Statistical analyses using t tests detected no significant effects of sex for the SOC scale (mean male score 1.82 ± 1.68, mean female score 1.85 ± 1.77; t=−0.05, df=33, p=0.96), for the SRP scale (mean male score 1.97 ± 0.98, mean female score 2.06 ± 1.19; t=−0.25, df=33, p=0.80), or for the ORQ scale (mean male score 2.58 ± 1.26, mean female score 2.47 ± 1.14; t=−0.27, df=33, p=0.79).

Empirical validity of the SOC scale, the SRP scale, and the ORQ scale was assessed by using established cutoff scores. Among the 35 patients with anosmia, 28 (80.0 %) reported abnormal olfactory capabilities, 26 (74.3 %) reported problems smelling odors, and 28 (80.0 %) reported smell-related problems in quality of life.

Convergent validity was examined via correlation of the ASOF to objective olfactory testing (Identification Test of the Sniffin' Sticks) using data of the patients with dysfunction. The correlations between scores of the Identification Test of the Sniffin' Sticks and the ASOF scales were moderate (SOC r=0.39, p=0.02; SRP r=0.07, p=0.69; ORQ r=0.30, p=0.08).

Discussion

Prior reports found that patients with olfactory dysfunction have problems in everyday life situations relating to smell (Shu et al. 2011). Although there are some instruments to measure specific aspects of olfaction-related quality of life (Neuland et al. 2011) and the importance of olfactory function in daily life (Croy et al. 2011), there is a lack of psychometrically validated easy to administer instruments concerning self-reported general olfactory capability, self-reported capability of reporting specific odors, and self-reported olfaction-related quality of life in patients with olfactory dysfunction.

Thus, we developed and validated a questionnaire for the ASOF in patients with olfactory dysfunction. Excellent reliability and validity of the ASOF was demonstrated by internal consistency above 0.85 for both the self-reported capability of reporting specific odors scale and the self-reported olfaction-related quality of life scale in normosmic controls as well as in patients with olfactory dysfunction. Item selectivity was psychometrically satisfactory for the capability of reporting specific odors scale and the self-reported olfaction-related quality of life scale in normosmic controls and patients with olfactory dysfunction. Factor analysis confirmed the item structure of the ASOF. The ASOF proved to be easy to administer, and it took participants roughly 5 min to fill in the ASOF questionnaire. Scoring of the ASOF questionnaire was generally achieved within 2 min.

The scale intercorrelations of the ASOF in normosmic controls and patients with olfactory dysfunction were medium to low, suggesting a good representation of the diversity of the construct. There was no effect of age or sex on any scale in normosmic controls and patients with olfactory dysfunction. A lack of association between age and sex and self-reported olfactory functioning is surprising due to the known age and sex effects for olfactory performance (Doty 2006). However, our results corroborate a previous study showing no effect of age and sex in normosmic controls and patients regarding a measure of individual importance of olfaction (Croy et al. 2011). Furthermore, the same study (Croy et al. 2011) did not find a significant coherence between a measure of individual importance of olfaction and odor threshold, odor discrimination, or odor identification in a sample of 235 normosmic controls, supporting our results. Similar results were found by a recent study investigating elderly participants (Wehling et al. 2011). Thus, in normosmic controls there seems to be no clear relationship between subjective self-reported olfactory functioning and age, sex, or olfactory performance as measured by means of Sniffin' Sticks.

Convergent validity of the ASOF with the Identification Test of the Sniffin' Sticks was successfully demonstrated. Olfactory performance was positively related to ASOF scales indicating that reduced sense of smell leads to more self-reported problems regarding olfaction in patients with olfactory dysfunction. Again, there was no such association in normosmic controls for all three scales.

All three scales discriminated significantly between normosmic controls and patients with olfactory dysfunction indicating the discriminative power of the ASOF. An approximately equal number of patients (roughly two-thirds) were identified by the three ASOF scales as having olfactory-related problems. This result showed that patients with olfactory dysfunction were equally impaired in the three olfactory domains assessed by the ASOF.

The current report confirmed earlier studies that indicated the negative effect of smell loss on safety functions such as the early detection of smoke, gas leaks, or spoiled foods. Our study also replicated the finding of a negative impact of olfactory dysfunction on the assessment of food and beverages and the detection of fragrances and aromas (Deems et al. 1991; Miwa et al. 2001).

Problems with personal hygiene in patients with smell loss have been previously reported (Deems et al. 1991). In our study, we found that patients with olfactory dysfunction have problems perceiving their own body odor and that of other people. As a consequence, patients with smell loss may eventually develop body insecurity (Temmel et al. 2002).

A potentially important new finding was that patients with olfactory dysfunction reported impairments in sexual life in part of the six-item olfaction-related quality of life (ORQ) scale. To date, we can only speculate on the clinical significance of

this result with respect to mate selection, intimate relations, and sexual reproduction; the true biological meaning of olfaction loss in patients should be investigated in future studies.

As every other study, the present study also has limitations. The present study did not investigate olfactory-related quality of life in patients with different etiologies. In order to understand the influence of such etiologies, more specific research is necessary. Thus, at our institution, further research is underway regarding differential aspects of olfactory-related quality of life in patients with different etiologies.

It was our goal to develop and validate an instrument assessing subjective olfactory functions in normosmic subjects and patients with olfactory dysfunction. We found the ASOF to have excellent psychometric properties and to be easy to use in clinical practice. As a next step, test–retest reliability and responsiveness of the ASOF to therapeutic intervention will be established in a future research project using longitudinal data. The ASOF is a new measure that can be used successfully to identify smell-related problems in patients with olfactory dysfunction. Specific knowledge of these problems is the first step to help patients cope with their impairments (Tennen et al. 1991), as psychological adjustment to reduced olfactory function is a dynamic process in patients with olfactory dysfunction (Croy et al. 2011; Shu et al. 2011).

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