Olfactory Function and Malnutrition in Geriatric Patients

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Background. Impaired olfaction is considered to be a risk factor for malnutrition in older adults; however, there is little research on this association. The aim of this study was to investigate whether olfactory deficits are associated with an impaired nutritional status in older patients.

Methods. Study participants were recruited from a geriatric day hospital. Nutritional status was assessed with body mass index and Mini-Nutritional Assessment. Olfactory function was evaluated with the Sniffin’ Sticks test (SST) and objectively rated by the patient. Self-caring capacity was rated with the Barthel Index and cognitive status with the Mini-Mental State Examination.

Results. One hundred ninety-one patients, 71.7% female, were included with a mean age of 79.6 ± 6.3 years. Prevalence of hyposmia was 39.3%, and 31.9% of patients were functionally anosmic. Malnourished patients did not have a significantly lower Sniffin’ Sticks test score than patients at nutritional risk or malnourished patients. In linear regression analysis, nutritional status was only influenced by Barthel Index, age, and number of drugs but not by olfactory function.

Conclusion. In this sample, olfactory function was not associated with nutritional status.

Key Words: Older adults—Nutritional status—Olfactory dysfunction.

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INTRODUCTION

Olfactory dysfunction in its clinically relevant form can be found in about 3%–8% of the general population; with increasing age, the incidence rises and can affect up to 60% of individuals over 65 years (1–3). There are numerous reasons for an impaired olfactory function including damage to the olfactory epithelium due to trauma; drugs or toxins; an age-related impaired ability to regenerate olfactory neurons; or reduced release of odor molecules due to impaired chewing (4–6). Also systemic neurological diseases such as Parkinson’s disease or Alzheimer’s disease have been associated with olfactory deficits. About 90% of patients with Parkinson’s disease exhibit smell impairment, mostly without noticing it (7). The mechanisms that lead to this impairment in neurological systemic disease are not yet completely understood, but it is hypothesized that early neuropathological changes of the rhinal brain may be responsible (8,9).

Malnutrition is a common finding in older persons, affecting up to 60% of hospitalized patients (10). Olfactory dysfunction alone or in combination with loss of taste is considered one risk factor for the development of malnutrition in the literature (11). However, there is little research on the consequences of impaired smell on nutritional status in older adults, and results are contradictory. In a study in free-living older women by Duffy et al. (12), impaired smell and taste function were associated with a lower interest in food preparation and a lower preference for sour or bitter fruits and vegetables. However, appetite, food intake, and body weight were not affected. In another study, Ferris and Duffy (13) investigated a sample of hyposmic and anosmic individuals of different ages attending a chemosensory clinic. Although enjoyment of food was lower and a change of eating habits was reported, nutrient intakes were found to be adequate. Interestingly, in this study, older women with an impaired olfactory function had a higher body weight than the national reference value. Temmel et al. (14) conducted an observational study in patients attending a smell clinic and reported various problems associated with food preparation and eating: 73% had problems with cooking, 68% suffered from an affected mood, 56% reported decreased appetite, and 50% had accidentally consumed decayed food. However, in this study, nutritional status was not assessed. A few studies have reported negative effects of impaired olfaction on nutritional status, such as a study by Simchen et al. (15), which showed that healthy individuals over 65 years with a body mass index (BMI) < 28 kg/m² had lower ability to identify and detect odors than participants with a BMI ≥ 28 kg/m².
The aim of this study was to investigate whether olfactory deficits are associated with an impaired nutritional status in a sample of older patients of a geriatric day hospital at time of hospital admission.

METHODS

Study Design and Data Collection

Participants.—Between March 2006 and August 2008, patients from a geriatric day hospital were asked to participate in the study. This outpatient hospital serves community-dwelling older adults who come for diagnosis and treatment of syndromes such as falls, osteoarthritis, and cognitive impairment. Exclusion criteria were age lesser than 60 years, lack of or withdrawal of informed consent, diagnosis of Parkinson’s disease, moderate or severe cognitive impairment defined as Mini Mental State Examination (MMSE) score less than 20, and smoking within the preceding year. All tests and assessments were performed within 2 days of hospital admission.

Assessment of functional status and cognitive function.—Self-caring capacity was evaluated with the Barthel Index, an instrument that assesses activities of daily living including mobility, grooming, feeding, and continence. The index is scored from 0 to 100, with 0 points indicating complete care dependency (16). Cognitive status was rated with the MMSE (17). A score of 20–25 points indicates mild or questionable cognitive impairment and more than 25 points indicates a normal cognitive status (18).

Determination of nutritional status.—Nutritional status was assessed with BMI (kg/m²) and Mini-Nutritional Assessment (MNA) Long Form. The MNA is a validated instrument to screen for malnutrition in older patients recommended by the European Society for Enteral and Parenteral Nutrition (19). The tool includes anthropometric measurements and questions on weight loss within the preceding 3 months, mobility, food intake, and self-perception of the patient. A score of less than 17 points indicates malnutrition, a score of greater than or equal to 17–23.5 points indicates patients at risk of malnutrition, and a score of 24–30 points indicates well-nourished patients (20).

Assessment of olfactory function.—The validated smell identification test Sniffin’ Sticks test (SST; 12-item; Burghart Medical Technology, Wedel, Germany) was performed to objectively evaluate global olfaction (21). This test involves the presentation of odorants in felt-tip pens. The pen’s tampon is filled with dissolved odorants of 12 common aromas. The pens are presented to the test person in a standardized way in a quiet, well-ventilated room. The pen’s tip is placed approximately 2 cm in front of both nostrils for 3 seconds, with an interval of 30 seconds between the different pens. In a multiple forced choice task, the test person has to identify the presented odor out of a list of four suggestions. In our study, the used pens were less than 6 months old, as recommended by the manufacturer. Participants were categorized as normosmic (10–12 points), hyposmic (7–9 points), or functionally anosmic (0–6 points) (22). In addition, patients rated their olfaction subjectively into one of three 3 categories (good, fair, or poor).

Concurrent drugs that are known to have potential effects on olfaction were identified and grouped (23). The following groups were formed: calcium antagonists, angiotensin converting enzyme (ACE) inhibitors, other antihypertensive drugs, diuretics, statins, antidepressants, and antirheumatics.

Statistical analysis.—Statistical analysis was carried out with SPSS Version 20 (IBM SPSS Statistics, Chicago, Illinois). Descriptive statistics were used for presentation of patient baseline characteristics. A comparison of means was performed using the t test or Mann–Whitney U test according to the data distribution. The chi-square test was applied to detect differences between nominal data. In order to examine the effect of potential influence factors on nutritional parameters and olfactory function, a linear regression analysis was performed. The level of significance was determined a priori at p < .05. The study was approved by the ethics committee of the University of Münster.

RESULTS

A total of 191 patients participated in this study. Mean age was 79.6 ± 6.3 years, and 71.7% of study participants were female. Although 67.4% of participants were nonsmokers, 32.6% had smoked in earlier years but not in the year before the study. Although 66.0% of study participants did not exhibit cognitive deficits, 34.0% had a mild or questionable cognitive impairment. Table 1 shows patients characteristics.

Olfactory Function

Prevalence of hyposmia in this sample was 39.3%, and 31.9% were functionally anosmic, as assessed with the SST. Eleven percent of patients considered their olfactory function as good, 44.5% as fair, and 44.5% as poor. Interestingly, 22.9% of patients with functional anosmia had subjectively rated their olfaction as good (Table 2). Men and women did not have a significantly different SST score (men 7.3 ± 3.2 vs women 7.5 ± 2.9, nonsignificant), neither did former smokers compared with nonsmokers (nonsmokers 7.4 ± 3.0 vs ex-smokers 7.5 ± 2.9, nonsignificant). In a group comparison, patients with functional anosmia had a significantly lower MMSE score than those with normal olfaction or hyposmia (Figure 1A). MMSE scores were not significantly different in participants who had rated their olfactory ability as good, fair, or poor.
Nutritional Status

Mean BMI was 27.6 ± 4.9 kg/m². Only four patients (2.1%) had a BMI < 20 kg/m², indicating underweight in older adults according to the German guidelines on Enteral Nutrition. According to the MNA, 62.3% of the participants had a good nutritional status, 34.6% were at nutritional risk, and 3.1% were malnourished. A comparison of well-nourished patients according to MNA with those at nutritional risk or with impaired nutritional status did not reveal a significantly lower SST score (7.4 ± 3.1 vs 7.5 ± 2.6, nonsignificant, see Figure 1B). In a group comparison of malnourished and well-nourished patients, subjectively rated olfactory function did not differ. In a linear regression analysis with MNA as dependent variable, Barthel Index was the only factor with significant influence. When entering BMI as dependent variable, age and number of drugs had an influence, whereas SST score, MMSE, and Barthel Index did not. SST score as dependent variable was affected by cognitive function and number of drugs, but not by age, Barthel Index, and MNA (see Table 3).

Medication and Olfaction

As the number of drugs appeared to have an impact on objectively rated olfactory function in regression analysis, we tested whether patients receiving drugs with potential side effects on olfaction had lower SST scores. We compared patients receiving calcium antagonists, ACE inhibitors,
other antihypertensive drugs, diuretics, statins, antide-
pressants, or antirheumatics. Apart from those individuals
receiving diuretics ($p = .001$), no lower SST scores could
be observed. Twenty-one patients received no potentially
smell-altering medication, and 56 patients received three or
more of those drugs. They did not have a significantly dif-
ferent olfactory function ($7.4 \pm 3.7 \text{ vs } 7.2 \pm 2.6$, nonsignificant).

**Discussion**

In this study, we found a high number of patients with
olfactory dysfunction; however, in this sample of geriatric
patients, no negative impact on nutritional status could be
observed.

Of the assessed patients, 39.3% of patients were hyposmic
and 31.9% were functionally anosmic. Population-based
studies in Germany and Sweden show that olfactory perfor-
ance decreases with age (1,24). In the study by Vennemann
et al. (24), olfactory function was assessed with the SST, and
in the subgroup of 65- to 74-year olds, 6% were functionally
anosmic and 20% were hyposmic. This is a lower prevalence
than recorded in our sample and is probably due to the lower
age range of the study population. An epidemiological study
in a population of free-living older U.S. citizens ($n = 2491$)
reported a prevalence of olfactory impairment of 24.5% in
the study population (2). However, olfactory impairment
increased with age, and a prevalence of 62.5% was found
in the subgroup of the 80- to 97-year olds. This is in accord-
ance with our prevalence data. Since participants in the cur-
rent investigation were community dwelling and generally
in good health (average Barthel Index = 80 points), we think
that our data can be considered comparable to those of the
general independently-living older population.

When asked to rate their olfactory ability subjectively,
22.9% of patients in our study considered their olfactory
function as good, despite being identified with anosmia with
the SST. Only 20.0% correctly rated their olfactory ability
as poor. This confirms findings of other studies such as one
by Murphy et al. (2), who reported a low self-reported
olfactory impairment of 9.5% (of 24.5% independently liv-
ing older adults diagnosed with an impairment). They also
reported that self-assessment becomes less accurate with
age. There seems to be a neglect of the dysfunction or an
adaptation to the impaired olfactory function that takes place
over the course of time. The authors of another study (13)
explain this by a better adaptation of older adults to reduced
olfactory ability than younger individuals, and, furthermore,
older adults seem to experience a less intensive decline in
enjoyment of food. The observed incongruence of objective
and subjective olfactory ability in our sample demonstrates
that it is not sufficient to ask the patient about olfaction, but
there needs to be a standardized testing of olfactory func-
tion. In clinical routine, this might be done by standardized,
easy-to-use quantitative tests such as the smell identifica-
tion test used in this study or other smell identification or
threshold tests suiting the respective population (25).

In general, men tend to have a poorer olfactory function
than women, which is supported by several studies (1,24).
In an epidemiological study by Schubert et al. (26), the odds
for men to develop olfactory impairment were more than
double compared with women. In our sample, however,
SST score did not differ significantly between men and
women, which could be due to the small number of men
included.

Despite the exclusion of patients with Parkinson’s dis-
ease and those with moderate or severe cognitive dysfunc-
tion, due to their known effects on olfaction, we observed
lower MMSE scores in participants with impaired olfactory
function. Indeed, smell identification tests have been used
in the differential diagnosis of dementia and severe depres-
sion or to confirm diagnosis of Parkinson’s disease (27).
Epidemiologic studies show that impairment of odor iden-
tification is associated with incident cognitive impairment
over subsequent years (7,22,23). Studies have been carried
out to investigate whether odor testing may be useful to identify patients at risk for cognitive decline; however, this is only confirmed in high-risk settings (28), which is why it is not suggested for routine use yet.

Smoking is a relevant factor that is associated with loss of olfactory function. Cigarette smoke is considered to be the most important toxin damaging the olfactory epithelium (29). In our population, no participant smoked at the time of the study, but one third had smoked earlier on in life. Nevertheless, olfactory ability was not significantly worse in those who were ex-smokers. A large population-based study by Murphy et al. (2) found that although current smoking was associated with olfactory impairment, olfactory function did not differ between former smokers and those who had never smoked cigarettes. Schubert et al. (26) found that only women had increased odds of developing olfactory impairment when they had smoked in earlier life. Vennemann et al. (24) confirmed the negative effect of current smoking in a population sample of 25- to 75-year-old Germans. The Skovde study on the contrary found no lower olfactory function in heavy smokers compared with those who never smoked (1). However, the authors argue that their smell test might not have been sensitive enough to detect a difference. It has been shown that long-lasting abstinence from nicotine can lead to a normalization of olfaction (5).

As all of our study participants had given up smoking several years or at least 1 year before hospital admission, olfactory function might have gone back to normative values.

In this study, neither subjective nor objective olfactory dysfunction was associated with an impaired nutritional status. This lack of association was also observed in community-dwelling older women and patients of a smell clinic that did not observe a decreased nutritional status in study participants with impaired olfactory function. Although interest in food preparation and enjoyment of food decreased, food intake and body weight were not affected (12,13). In both studies, especially older women increased their intake of sweets and highly calorific food, resulting in high body weight. The authors report compensatory strategies such as preference for foods with enhanced primary taste qualities such as salty or sugary food. This is explained by the fact that those qualities can be experienced although olfactory function is impaired. Also enhanced textures (such as a creamy texture) become more important, both strategies resulting in an increased intake of sweets and highly calorific food (12). Schubert et al. (26) reported in their population-based study that although participants with olfactory impairment felt that food did not taste as good as when they were younger, their dietary choices were not associated with olfactory impairment. Mattes (30) suggested in a review that as no association was found between decreased chemosensory perception and impaired nutritional status, the provision of adequate nutrition was so central to survival that the organism holds several mechanisms to ensure an adequate stimulus for sufficient food supply. From an evolutionary perspective, olfactory and taste functions seem to be necessary for the discrimination of fresh and healthy food from decayed and unhealthy food, via the mechanism of promoting pleasure. However, they do not seem to be essential to ensure adequate calorie intake.

Olfaction is the predominant contributor to flavor (31). The rationale of enhancing flavor to increase intake in older adults with chemosensory deficits has been pursued in some small intervention studies. Results, however, are contradictory. Mathey et al. and Schiffmann et al. (32,33) found positive effects of flavor enhancement on nutrient intake, resulting in weight gain and improved grip strength in older nursing home residents. Essed et al. (34), on the other hand, could not observe an effect of flavoring with monosodium glutamate on energy intake and body weight in older long-term care residents. Further studies are needed to prove the effect of this approach in malnourished older adults with chemosensory deficits. As our study showed that poor olfaction does not worsen nutritional status, we would not expect flavor enhancement to increase intake or improve nutritional status; however, this needs to be confirmed by further studies.

Certain drugs, such as ACE (Angiotensin-converting enzyme) inhibitors, diuretics, and antidepressants, are thought to negatively impact olfactory function (35,36). ACE inhibitors for instance are suggested to influence olfaction in 10% of all patients, which could not be reproduced in our population. In a linear regression analysis, the number of drugs taken by an individual can number of drugs taken by one patient had a significant influence on the SST score. The number of drugs taken by an individual can be seen as a surrogate indicator of disease severity and the presence of chronic disease, which could increase the risk of olfactory impairment. In a group comparison, however, only patients receiving diuretics had a significantly lower SST score. Murphy et al. (2) suggested in their study that on a population level, medication use may not be a major contributor to the prevalence of olfactory impairment. It may be that the influence of certain drugs on olfactory function is overestimated; however, the current investigation might not have had enough power to detect an influence.

One limitation of the study includes the cross-sectional design, which does not allow to establish a cause-effect relationship between olfaction and nutrition status. Furthermore, a potential selection bias has to be taken into account, as our sample only included patients attending our day care clinic and as our selection criteria favored higher functioning older adults. This might make our results less generalizable to groups at higher risk of nutritional deficiency. A further point that has to be addressed is the method used for assessing olfactory function. The SST is an instrument for the global assessment of olfactory function recommended by the German Society of Oto-Rhino-Laryngology, Head and Neck Surgery (37). Due to their nature, identification tests (eg, University of Pennsylvania Smell Identification Test and San Diego Odor Identification...
Test) (38,39) are crude measures of olfaction that have a certain potential for misclassification of participants due to measurement error. Nowadays, most centers use a combination of threshold and identification tests, which had not yet been validated for the SST battery at the time of the study. More sophisticated methods, such as electroolfactograms, are only available in selected medical or research centers (25) and not routinely used in clinical routine.

Although it is a generally accepted fact that reduced olfactory function is associated with impaired nutritional status, the body of research existing in this area up until now indicates that consequences on nutritional status are not as deleterious as we would expect.

One consequence that should be drawn from the impressive subjective underestimation of olfactory impairment would be the promotion of objective olfactory screening and testing if complaints with olfaction are present or cognitive impairment or Parkinson’s disease are suspected.

**Conclusion**

In this study, olfactory dysfunction and nutritional status were not associated. The only factors influencing nutritional status in regression analysis were age, number of drugs, and decrease in activities of daily living score. Factors influencing olfaction were cognitive function and number of drugs. A high number of patients had falsely rated their olfactory dysfunction as good, whereas they were considered functionally anosmic by an objective test. This underlines the need to use standardized tests to evaluate olfactory function in older adults.

**Author’s Contributions**

A.T. performed data acquisition. C.S. and R.W. performed data analysis, data interpretation, and writing of the manuscript. A.F. and C.S. critically reviewed and edited the manuscript.

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**Conflict of Interest**

There is no conflict of interest. This work has not received any financial support.

**References**


