A strong relation between the sense of smell and nutritional status in geriatric patients

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Foreword

This scientific paper was written in the context of our graduation for the Bachelor Nutrition and Dietetics at the Amsterdam University of Applied Sciences. This article presents the results of a cross-sectional study on the sense of smell and the nutritional status in geriatric patients. The study was performed by order of clinical geriatrician J.P.C.M. van Campen of the Slotervaart Hospital. This article will be sent to a medical journal with the aim of publication.

We were able to work in a professional environment for this study, which gave us the opportunity to gain experience in research and work with geriatric patients. We experienced our graduation period as very instructive. It helped us to improve our scientific writing skills, our English and to gain insight into the topic of this article.

We would like to thank J.P.C.M. van Campen and C. Pleune for their professional guidance and constructive criticism. We also want to thank our teacher tutor M.J.J. de Bos Kuil for his involvement and support in our graduation process. Beside we would like to thank P.J.M. Weijs for his assistance in the statistical analysis.

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Abstract

Background: This cross-sectional study was designed to investigate the relationship between the sense of smell and the nutritional status in geriatric patients who visited the geriatric diagnostic day clinic or outpatient clinic of the Slotervaart Hospital, a teaching hospital located in Amsterdam. The study was carried out between March and May 2012.

Materials and methods: Nutritional assessment was performed by 88 participants (61 females, mean age 82.3 ± 6.5 years) using the Mini Nutritional Assessment-Short Form (MNA-SF). The Sniffin’ Sticks - Screening 12 Test was used to investigate the olfactory function of 75 participants (54 females, mean age 81.7 ± 6.6 years).

Results: Forty-nine percent of the participants were at risk of malnutrition, 16% were malnourished and 35% had a normal nutritional status. More than half of the participants (57.3%, n= 75) appeared to be hyposmic, 28.0% appeared to be anosmic and 14.7% had a normal sense of smell. Linear regression analysis demonstrated a strongly significant relationship (p= 0.004) between the sense of smell and nutritional status. Corrected for possible confounders the relationship remains significant at a p-value of 0.005.

Conclusions: This study showed that the sense of smell is related to nutritional status in this study population. Our results confirm that the loss of smell and malnutrition are common problems among geriatric patients.

Key words: olfaction, nutritional status, elderly

Introduction

In contemporary Western society the age group of above 65 year is the fastest growing part of the population. At least 15% of the Dutch population is 65 years and older. 1 In 2040 this percentage is expected to increase to more than 25%. 2 Aging comes with an increased risk of multimorbidity. More than 50% of the Dutch people aged 65 years and older suffer from one or more chronic diseases. 3 Multi-morbidity is the most important cause of malnutrition in geriatric patients. The nutritional intake is influenced by the several diseases that are simultaneously present and by mutual interactions of these diseases. 4 Thirty-two percent to 61% of the geriatric patients in the Netherlands are malnourished. 5,6 Malnutrition is a major threat to the independence and quality of life of vulnerable older people because the sequelae of malnutrition include physical, mental and social disability. 7 Common causes of malnutrition found in this age group are acute illness, polypharmacy, gastrointestinal problems (nausea, constipation and diarrhea), neurodegenerative disorders (dementia and Parkinson’s disease), stress, isolation and chemosensory disorders. 8 Several studies have shown that a large number of the elderly have a reduced sense of smell. The relation between olfactory impairment and aging has thus been proved. 9,10 In the US more than half of the people aged between 65-80 years have a reduced sense of smell. For people aged over 80 years this percentage is even 75%. If this percentage would apply to the Netherlands, between 500,000 and 950,000 persons aged 65 and older would have a reduced sense of smell. 11
The loss of sense of smell can be partial, called hyposmia, or complete, called anosmia.\textsuperscript{12,13} Besides aging the sense of smell can be reduced as a result of dementia, upper airway infections, head trauma, toxic exposure to tobacco or smoke, endocrine disorders (hypothyroidism and diabetes mellitus), chronic renal failure and liver disease.\textsuperscript{14-16} Several medications can affect the sense of smell, for example Amlodipine, Enalapril and β-sympatholytics in general.\textsuperscript{17} Olfactory impairment can be one of the first indications of several age-related neurodegenerative disorders, like Alzheimer’s disease or Parkinson’s disease.\textsuperscript{18-20} The number of people with dementia strongly increases with age. Up to 30-35% of the people aged above 85 years suffers from dementia, where Alzheimer is de most common cause of dementia (about 50-70% of cases).\textsuperscript{21,22} Although the diminishment of the sense of smell is not a life-threatening problem, it may affect the quality of life of the elderly.\textsuperscript{23} It can also result in significant changes in appetite and food preferences, which influence nutritional status.\textsuperscript{24} This article concerns a study on the relationship between the sense of smell and the nutritional status in geriatric patients. Apart from demographic data, Geriatric Depression Scale (GDS), cognitive status by means of the Mini-Mental State Examination (MMSE)\textsuperscript{25} and the 7 Minute Screen (Benton Temporal Orientation, Enhanced Cued Recall, Clock Drawing and Verbal Fluency)\textsuperscript{26,27} were performed. Patients were excluded for the investigation if they scored 18 or lower on the MMSE. Below a score of 19, patients are suffering a serious cognitive disorder which implicates that the answers on the smell test are not reliable.\textsuperscript{28} Final conclusions regarding the presence and type of cognitive decline were recorded from the discharge letter (no cognitive disorder, mild cognitive impairment or dementia). Laboratory tests (including vitamin B\textsubscript{1}, folate and vitamine B\textsubscript{12}) were taken of all patients. All participants were individually tested for their sense of smell and nutritional status. Six patients had a score of 18 or lower on the MMSE, and therefore excluded for nutritional assessment and the odor stimuli test. In addition, eight patients did not want to perform the odor stimuli test and five patients were excluded because of an upper respiratory infection.

**Materials and methods**

**Participants**

Participants were recruited from all the patients who visited the geriatric diagnostic day clinic or outpatient clinic of the Slotervaart Hospital, a teaching hospital located in Amsterdam between March 26 and May 29, 2012. Table 1 shows the characteristics of the participants. All experimental procedures were explained in full detail to the participants, who gave written informed consent. The study protocol was also approved by the ethical committee of the hospital.
Odor stimuli
The Sniffin’ Sticks - Screening 12 Test was used to investigate the olfactory function of 75 participants (54 females, mean age 81.7 years, ± 6.6 years). This identification test is suitable in a clinical setting and commercially available. The test has a high test-retest reliability ($r_{24} = 0.73$ and $r_{113} = 0.77$), it differentiates between the olfactory function in men and women and discriminates age-related changes in the olfactory function. The screening takes approximately 4 minutes to be administered. The Sniffin’ Sticks - Screening 12 Test consists of 12 odor pens, which all contain harmless odors. Each odor pen was presented approximately 2 cm in front of both nostrils. All participants were asked to sniff each odor pen for 3-4 seconds and were then asked to identify the odors. They were offered four possible answers (forced choice). Only one of these answers correctly describes the scent. The test differentiated anosmic (score 0-5), hyposmic (score 6-9) and normosmic (score 10-12) conditions.

Statistical analysis
Results were analyzed with SPSS statistical software version 19.0 for Windows. Skewness and kurtosis shows that the MNA-SF data were normally distributed. Linear regression analysis was performed to evaluate the possible relation between the sense of smell and nutritional status. To compare the BMI and laboratory test within the different groups of smell function ANOVA e.g. Kruskall Wallis were used. Logistic regression analysis was used to investigate if the number of correctly recognized odors can predict the nutritional status. The level of statistical significance was $p< 0.05$.

Results
The MNA-SF showed that the vast majority (48.9%) of the participants (n= 88) were at risk of malnutrition, 15.9% were malnourished and 35.2% had a normal nutritional status. The mean score on the MNA-SF in women and men was nearly equal, respectively $10.0 \pm 2.8$ and $9.7 \pm 2.4$.

More than half of the participants (57.3%, n= 75) appeared to be hyposmic and 28.0% appeared to be anosmic. A small percentage (14.7%) of the participants had a normal sense of smell (normosmic). Figure 1 shows that the mean score
on the MNA-SF was 9.1 ± 2.5 for the participants that were anosmic, against 10.0 ± 2.7 for the participants that were hyposmic and 11.6 ± 2.3 for the participants that were normosmic. There is a significant difference (p= 0.041) in the MNA-SF score between these three groups. The mean score of the number of correctly recognized odors by women and men was nearly equal, respectively 6.8 ± 2.6 and 6.7 ± 2.7. No significant difference of the score on the MNA-SF and the number of correctly recognized odors was found in gender.

A strong linear relationship (p= 0.004) between the sense of smell and nutritional status was found using linear regression analysis (Table 2). Corrected for possible co-founders (GDS score, smoking, gender, age and MMSE score) the relationship slightly drops down but stays significant at a p-value of 0.005. For each unit increase in correctly recognized odors, the score on the MNA-SF is predicted to increase by 0.364 (95%CI 0.113 - 0.615).

In addition, linear regression analysis showed that the BMI was significantly (p= 0.014) increased by a higher score on the odor test (b= 0.500, 95%CI 0.104 – 0.896).

No significant difference was found in the number of correctly recognized odors among participants that had no cognitive disorder, mild cognitive impairment or dementia.

There was no significant relationship found between vitamin B1, folate and vitamine B12 levels and the number of correctly recognized odors. In contrast to the BMI, folate and vitamin B12 levels, the distribution of vitamin B1 levels is not the same (p= 0.044) across participants with anosmia, hyposmia and a normal sense of smell. No significant differences were found in the BMI, vitamin B1, folate and vitamin B12 among participants that are malnourished, at risk of malnutrition or with a normal nutritional status. To investigate which cut-off point in the number of correctly recognized odors gives the best specificity and sensibility for determining malnutrition or a risk of malnutrition, a ROC-curve is created. The highest area under the curve (0.619) for malnutrition was found at 8 or less correctly recognized odors. The highest area under the curve (0.592) for participants at risk of malnutrition was found at 10 or less correctly recognized odors. Logistic regression analysis showed that these numbers of correctly recognized odors were no significant predictor in determining malnutrition or a risk at malnutrition.

### Table 2
Unstandardized coefficients, 95% confidence intervals and p-values for the relationship between the sense of smell and nutritional status (dependent variable).

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficient</th>
<th>95%-CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple analysis</td>
<td>0.338</td>
<td>0.110 - 0.566</td>
<td>0.004</td>
</tr>
<tr>
<td>Corrected analysis*</td>
<td>0.335</td>
<td>0.105 - 0.565</td>
<td>0.005</td>
</tr>
<tr>
<td>Corrected analysis**</td>
<td>0.364</td>
<td>0.113 - 0.615</td>
<td>0.005</td>
</tr>
</tbody>
</table>

* Corrected for GDS and smoking
** Corrected for GDS and smoking, according as gender, age and MMSE

**Discussion**

The results of the presented study show a relationship between the sense of smell and nutritional status in geriatric patients of the geriatric
diagnostic day clinic or outpatient clinic of the Slotervaart Hospital.

Several sources in the literature describe a relation between a reduced sense of smell and age. In a cross-sectional study C Murphy et al. (n= 2491, mean age 68.7 years ± 9.4 years) show that the prevalence of olfactory impairment among older (age 80-97 years) adults is high and increases with age. This corresponds to our study that shows high numbers of participants with hyposmia (57.3%) and anosmia (28.0%).

Few studies have previously reported about a relation between olfactory function and nutritional status. A cross-sectional observational study (n= 41, mean age 50.8 years ± 11.2) from AC Raff et al. describes a relation between poor nutritional status and impaired olfactory function in end stage renal disease patients. Our results support the relation between nutritional status and impaired olfactory function, but in a totally different study population. To our knowledge no comparable study was performed among a population of geriatric patients. Given the high prevalence of undernutrition in this group of patients these findings are highly relevant.

In a cross-sectional study (n= 200, age 60-90 years) among elderly MI Griep et al. concluded that people with poor odor perception have lower nutrient intake levels than people with good odor perception. In a review SS Schiffman et al. describe that loss of smell is present among three quarters of the elderly persons above 80 years and is likely to affect appetite and nutritional status. Our results show that participants that appear to be anosmic had the lowest nutritional status. We suggest that the loss of smell has an impact on the appetite and nutrient intake levels as described in the study of MI Griep and SS Schiffman. In contrast, a study by AM Ferris et al. (n= 230) compares the effect of smell dysfunction on nutritional status in a younger (age 25-45 years) versus an older (age ≥ 60 years) cohort and shows that chemosensory impairment does not lead to nutritional problems, except for calcium intake in the elderly cohort and iron intake in the young cohort. This may be due to the large use of vitamin- and mineral supplements in the younger and older cohort, respectively 52% and 65%. Further research is necessary to clarify the relation between the sense of smell and the impact on nutrient intake levels among geriatric patients.

This article emphasizes that malnutrition is a common problem among the elderly. Only 35.2% of the investigated participants had a normal nutritional status. In a study of E. van der Heijden et al. an outline of this problem has been drawn. There are however several comments to be made to this study. The study population was small and the majority of the participants were women. This may limit the generalizability for our findings. On the other hand, the group of elderly patients we studied represent a group of patients with a high burden of comorbidity.

Olfactory function was measured with the Sniffin’ Sticks - Screening 12 Test. While this is a validate test to investigate the olfactory function it only gives a rough answer to the question whether a participant has normal or diminished olfactory capability. The extended version of the Sniffin’ Sticks is more precise, consists of 48 odor pens and incorporates subtests for odor threshold, discrimination and identification. However, this extended version of the test takes approximately 30-40 minutes and is therefore more stressful for this study population.

Conclusion

This study shows that the sense of smell is related to nutritional status. In addition, our results confirm that loss of smell and malnutrition is a common problem among geriatric patients. This suggests
that a reduced sense of smell has an impact on nutritional status and may affect the quality of life in the elderly. Based on this study we recommend routinely screening for malnutrition in geriatric patients in second-line care. In case malnutrition is found we additionally advocate investigating the sense of smell in this population by trained geriatric nurses. A dietician can respond to this problem and improve the nutritional intake by a nutritional intervention that meets physical needs with enough tastes and flavours.

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References


