Relationship between oral health and nutrition in very old people

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Abstract

Objective: to evaluate the relationship between oral health status and nutritional deficiency.

Design: cross-sectional clinical study.

Subjects: 324 institutionalized frail older adults (mean age 85).

Measurements: structured oral examination including an evaluation of mucosa, periodontal state, caries prevalence and denture quality. The nutritional status was assessed using serum albumin concentration and the body mass index. Physical dependence was assessed using the Barthel index. To identify oral health disorders associated with markers of malnutrition we performed the Pearson $\chi^2$ test separately for edentulous and dentate patients. Subjects with at least one of the identified oral disorders were classified as having compromised oral functional status.

Results: about two-thirds of the subjects were functionally dependent and half had either a body mass index <21 kg/m² or serum albumin <33 g/l. Among the edentulous, wearing dentures with defective bases or not wearing dentures at all were the factors most associated with malnutrition. In dentate subjects, corresponding identifiers were the number of occluding pairs of teeth (five or fewer, either natural or prosthetic), the number of retained roots (four or more), and the presence of mobile teeth. According to these criteria, 31% of the subjects had a compromised oral functional status. This was more frequently found in dependent subjects (37%) than semi-dependent subjects (18%; odds ratio, 2.6; 95% confidence interval, 1.4–4.8). Those with compromised oral functional status had a significantly lower body mass index and serum albumin concentration.

Conclusion: specific detrimental oral conditions are associated with nutritional deficiency in very old people.

Keywords: body mass index, geriatric dentistry, malnutrition, serum albumin

Introduction

Nutritional deficiency, in particular protein-energy malnutrition, is common in older adults. About 60% of older adults in long-term care facilities are malnourished [1]. There are many causes of malnutrition and it is not always easy to distinguish the age-related from the pathological [2]. Some have malabsorption [3]. Predisposing factors include poverty, disability, false beliefs about diet, depression and cognitive impairment [1, 4–7].

Teeth are not a prerequisite for proper digestion in healthy individuals [8, 9]. However, edentulous subjects with poor masticatory function take more drugs for digestive disturbances than those with a better masticatory function [10]. Furthermore, impaired masticatory function may lead to food selection and an unbalanced diet in older adults [6, 11–19]. Besides masticatory efficiency, several oral conditions—including painful mucosal disorders [1], oral dryness [20] or the pain and discomfort associated with periodontal disease or caries—may be related to difficulty in chewing.

The aim of this study was to evaluate the possible association between malnutrition (identified by biological markers) and oral health status in very old subjects. Our hypothesis was that a poor dental or prosthetic status would be associated with nutritional deficiency.

Materials and methods

The second largest nursing home (maximum capacity 275 residents) in the canton of Geneva was chosen for a longitudinal study on the oral health, general health and
nutritional status of older people. The home was a long-stay care facility with medical supervision, and all residents were 65 or over and mentally or physically disabled. No dentist had been involved specifically in the care of residents before the study. Most residents (69%) had their dental treatment covered by a government plan. The present study reports on data collected from March 1993 to March 1995. The study was approved by the Geneva Dental School ethical committee. Oral consent was obtained from the residents when their mental health permitted. Those who could not give an answer because of cognitive impairment were excluded. When there was doubt about the cognitive capacity of a resident, the decision rested with the resident’s physician.

Medical data, taken from the patient file, included height, weight and serum albumin concentration. The body mass index (BMI) was computed from the weight (in kg) divided by the square of the height (in m). A BMI < 21 kg/m² was considered as a marker of malnutrition [21]. The biological assessments were made biannually and the latest available data were used in the study. Serum albumin was measured by colorimetric technique based on bromcresol assay (Kodak Ektachem, model DTSC II; Eastman Kodak Company, Rochester, NY, USA) with a coefficient of variation of 2.3%. This technique gives higher values than the nephelometry technique [22] and the cut-off value indicating malnutrition was chosen at <33 g/l (which corresponds to the 30 g/l given by Rapin et al. [23] using the nephelometry technique). The degree of disability was evaluated using the Barthel index with a score of ≤20 indicating dependence [24].

One dentist performed all the oral examinations. When plaque accumulation was too heavy to enable an accurate clinical diagnosis of caries, a second examination took place after the patient had received treatment from a dental hygienist [25]. The quality of removable dentures was evaluated according to a gravity scale from unstable dentures through loose denture, gross occlusal inadequacy, no fault and defective base to missing denture [26]. Only the worst fault was recorded. Teeth with active caries (i.e. root, coronal, or secondary caries [27, 28]) as well as teeth with pulpal exposures were recorded. Periodontal disease was scored for each tooth according to the community periodontal index of treatment needs method [29] and the scores translated into a 5-point scale for each patient. Mucosal diseases were classified into localized or generalized stomatitis, denture-induced ulcers and ‘various’ [30].

Statistical analysis

We used the Kolmogorov–Smirnov goodness-of-fit test to evaluate the normality of the distribution. Thus, age, BMI and serum albumin were normally distributed, while the Barthel index and number of teeth were not.

Correlations were assessed using Pearson’s R coefficient when data were normally distributed. Otherwise, the Spearman rank coefficient was computed. Comparisons between two groups were performed with the Student’s t-test. Since age was correlated with the two nutritional markers (albumin and BMI), we compared these markers on the age-adjusted means using an ANOVA procedure, with age introduced as a covariate. Associations between the dichotomized markers of malnutrition and oral health disorders were tested separately on edentulous and dentate subjects using χ² tests. When age was a confounding factor, two cross-tabulations were run, one with the group of younger and the other one with the group of older subjects. The median age was used to split the sample in two groups of equal size. A new dichotomous variable—oral functional status—was created, based on the results of the χ² tests. Subjects who suffered from at least one of the oral health disorders associated with either or both nutritional markers were classified as having compromised oral functional status. The new dichotomous variable was then used to evaluate the possible interaction between nutritional markers, level of dependency and oral health status.

Results

A total of 324 residents were examined. The mean age was 85 years (SD 6.9) and 70% were women. About half (56%) of the residents or their husbands had been non-qualified workers, 31% had been qualified workers and 11% had been housewives. Only one (an architect) had been to university. Half (49%) of the subjects were edentulous.

Nutritional status

Overall, 52% of the sample had at least one of the two biological markers of nutrition lower than the selected cut-off. The mean BMI was 22.5 kg/m² (SD 4.5) and the mean serum albumin was 34.7 g/l (SD 3.4). The two biological markers were weakly but significantly correlated to each other (Pearson correlation: 0.18, P < 0.01) and negatively correlated to age (Pearson correlation: -0.19 and -0.21 for BMI and albumin respectively, both P < 0.01). Thus, the older the subject, the lower the value of the biological markers. There was no relationship between biological markers and profession nor between biological markers and any recorded disease. However, the dependent subjects had a lower serum albumin concentration than the semi-dependent subjects (age-adjusted mean albumin: 34.3 g/l and 35.5 g/l respectively, P = 0.01).

Oral findings

Of the 160 edentulous subjects, 14% had no dentures, 14% did not use a lower denture, 12% had one or two
unstable dentures, 32% had one or two loose dentures, 23% wore a denture with defective base and 45% had denture stomatitis or denture-induced ulcers.

The main characteristics of the dentate subjects are shown in Table 1. Only 20% of subjects were caries-free. One-fifth (20%) had at least one tooth with pulpal exposure or a retained root. Many (61%) wore removable dentures. One-fifth (20%) of the dentate subjects had denture stomatitis or denture-induced ulcers, while only 4% suffered from other types of mucosal disorders (such as white lesions or aphthous ulcers).

**Relationship between nutritional markers and oral health**

The mean serum albumin and mean BMI of the sample stratified by degree of dependency and dental status are presented in Table 2. The dentate, dependent or semi-dependent subjects were younger than the edentulous dependent subjects (t-value: 3.84, P < 0.01) who were the oldest. A two-way analysis of variance with age as covariate showed that both dependency and dental status were significantly associated with serum albumin level (P = 0.009 and P = 0.058 respectively) but not with BMI (P = 0.10 and P = 0.32).

Among the edentulous subjects, a BMI of <21 was found more often in non-denture wearers than in those using one or two dentures [odds ratio (OR): 2.9, 95% confidence interval (CI): 1.1–7.8]. Edentulous subjects who wore dentures with defective bases had a tendency to have a lower serum albumin (34.0 against 35.4 g/l, respectively; ANOVA with age as covariate, P = 0.10). There was no other relationship between the nutritional variables and the quality of the dentures or the presence of mucosal disorders among edentulous. Based on these results, edentulous subjects who did not have any dentures or used dentures with defective bases were considered to have a compromised oral functional status.

Among the dentate subjects, those with fewer than six occluding pairs of teeth (either natural or prosthetic) had a significantly lower serum albumin (33.0 against 34.7 g/l, respectively; ANOVA with age as covariate, P = 0.03). Subjects who had teeth with vertical mobility combined with pockets greater than 6 mm had a serum albumin < 33 g/l more often (OR: 2.6, 95% CI: 1.4–4.8). There was no other relationship between oral health variables and the biological markers. Thus, we considered dentate subjects with fewer than six occluding pairs of teeth, or those who had more than three retained roots or at least one tooth with vertical mobility, to have a compromised oral functional status.

In all, 31% of the subjects had a compromised oral functional status according to these criteria. The presence of a compromised oral functional status was more common in dependent (37%) than semi-dependent subjects (18%); OR: 2.6, 95% CI: 1.4–4.8). Both BMI and albumin were lower in subjects with a compromised oral functional status (Table 3). According to the two-way ANOVA models, oral functional status was a significant factor interfering with BMI and albumin while dependence was only significantly associated with albumin (Table 4). Serum albumin and BMI were lower when a compromised oral functional status was present among dependent but not among semi-dependent subjects (Table 3).

**Discussion**

The characteristics of the sample were similar to subjects admitted to a geriatric hospital [31, 32]: the same proportion was malnourished and most had a poor dental state. The sample therefore seems representative of very old frail older adults.

### Table 1. Oral characteristics of dentate subjects

| Median no. of teeth (inter-quartile range) | 9 (5–18) |
| Subjects with caries | 79% |
| Median no. of caries when present (inter-quartile range) | 3 (2–4) |
| Subjects with retained roots | 48% |
| Mean no. of retained roots when present (inter-quartile range) | 2 (1–4) |
| Periodontal index (derived from community periodontal index of treatment needs) |
| 0. No sign of gingivitis on any tooth | 4% |
| 1. Generalized gingivitis | 5% |
| 2. Presence of visible calculus | 35% |
| 3. More than three teeth with pockets of 4–5 mm vertical mobility | 30% |
| 4. At least one tooth with pocket >6 mm or vertical mobility | 26% |

### Table 2. Biological measures and age according to degree of dependency and dental status (edentulous/dentate)

<table>
<thead>
<tr>
<th>Dependency and oral status</th>
<th>Edentulous Dentate</th>
<th>Edentulous Dentate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=98)</td>
<td>(n=95)</td>
</tr>
<tr>
<td><strong>Body mass index (kg/m²)</strong></td>
<td>21.5</td>
<td>23.1</td>
</tr>
<tr>
<td><strong>Serum albumin (g/l)</strong></td>
<td>34.8</td>
<td>33.9</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>87.3¹</td>
<td>83.1</td>
</tr>
</tbody>
</table>

¹Significantly higher than all others at P < 0.01.

Data on dependence were missing in five subjects.
No attempt was made to record the diet of each resident, since all the meals came from the same kitchen and a dietician selected the menu items. In any case, many residents left food on the plates and the wastage was difficult to quantify.

We had not expected that the lowest serum albumin would be found in the dependent dentate residents. Apart from being younger than the edentulous residents, the dentate dependent subjects were no different in terms of general health. A similar finding has been reported recently among older adults at home [19]; the edentulous subjects had a higher micronutrient intake than those with an inadequate dental status.

Objective assessments have demonstrated that the loss of teeth (whether or not replaced by removable dentures) will decrease masticatory function [11, 13–15]. In our study, the presence of fewer than six occluding pairs of teeth was one of the two best predictors of malnutrition, whereas in edentulous subjects the absence of dentures was strongly associated with a low BMI. However, neither BMI nor albumin was lower in the edentulous than the dentate group. Similar findings have been reported in women of retirement age [33]. The edentulous subjects wearing one denture did not differ in nutritional status from those with a set of dentures. Perhaps malnutrition is associated with poor masticatory function only when the situation is severely compromised, such as in the absence of both dentures or when fewer than six chewing units are present.

A direct but often weak relationship between poor dental state and insufficient dietary intake has been reported in older people [6, 12, 17, 18]. Similarly, in our study, the relationship between specific oral disorders and poor nutritional status was weak. Caries were not related to malnutrition. Our findings are consistent with another study [18]. However, with the grouping of the disorders under the general term ‘compromised oral functional status’, the relationship became stronger. We found that the dependent subjects with a compromised oral functional status had the lowest BMI and albumin, while there was no difference among semi-dependent subjects with or without a compromised oral functional status. A compromised oral functional status had little influence on the nutritional status of semi-dependent elders, while those in poorer health might be more susceptible to poor oral function.

The types of oral health disorders highlighted by the analysis revealed neglect of mouth care. The large

<table>
<thead>
<tr>
<th>Dependency and oral functional status</th>
<th>Semi-dependent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate (n = 146)</td>
<td>Compromised (n = 82)</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>22.9*</td>
</tr>
<tr>
<td>Serum albumin (g/l)</td>
<td>34.7*</td>
</tr>
</tbody>
</table>

aSignificant difference at P ≤ 0.05 while adjusting for age.
Data on dependence were missing in five subjects.

Table 3. Mean biological measures according to degree of dependency and oral functional status

Table 4. Multivariate analysis ANOVA: effect of the degree of dependence and the oral functional status on serum albumin and on body mass index

<table>
<thead>
<tr>
<th>Measure</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect on serum albumin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependence</td>
<td>5.21</td>
<td>0.231</td>
<td>2.258</td>
<td>0.024</td>
</tr>
<tr>
<td>Oral functional status</td>
<td>0.443</td>
<td>0.229</td>
<td>1.933</td>
<td>0.054</td>
</tr>
<tr>
<td>Age</td>
<td>-0.096*</td>
<td>0.031</td>
<td>-3.086</td>
<td>0.002</td>
</tr>
<tr>
<td>Effect on body mass index</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependence</td>
<td>0.398</td>
<td>0.314</td>
<td>1.269</td>
<td>0.206</td>
</tr>
<tr>
<td>Oral functional status</td>
<td>0.615</td>
<td>0.302</td>
<td>2.039</td>
<td>0.021</td>
</tr>
<tr>
<td>Age</td>
<td>-0.107*</td>
<td>0.040</td>
<td>-2.637</td>
<td>0.009</td>
</tr>
</tbody>
</table>

a*β coefficient.
plaque deposits observed on the teeth and the dentures corroborate this. Oral health is important for the general health and well being of older people [33–39]. Compromised oral health is a factor contributing to nutritional deficiency in very old and frail adults. A dentist and a dental hygienist should, therefore, be included in the team of health professionals who care for older people.

Key points
- Poor oral health is common in institutionalized old people.
- A compromised oral functional status is found more often in dependent residents.
- A compromised oral functional status seems to be associated with nutritional deficiency.
- Preventive measures and simple dental procedures should be part of the routine care of people in nursing homes.

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References

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