Connections between tooth loss and adequate nutrition

Beáta Bolerázska¹, Richard Krotký¹, Janka Kluknavská², Silvia Timková¹, Janka Vašková²***

¹Department of Stomatology, Faculty of Medicine, Pavol Jozef Šafárik University in Košice, Tr. SNP 1, 040 11, Košice, Slovak Republic
²Department of Medical and Clinical Biochemistry, Faculty of Medicine, PavolJozefŠafárik University in Košice, Tr. SNP 1, 040 66 Košice, Slovak Republic

**Corresponding author**
Department of Medical and Clinical Biochemistry, Faculty of Medicine, PavolJozefŠafárik University in Košice, Tr. SNP 1 04066 Košice, Slovak Republic;
Email: janka.vaskova@upjs.sk

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**ABSTRACT**

*Background:* There is increasing evidence of the relationship between oral and general. Central to this role are the detrimental effects of tooth loss, particularly the associated change in diet. *Objective:* The aim of the work was to evaluate and compare nutritional status in elderly patients, over 60 years of age, for selected parameters, with the aim of preserving the state of teeth and prosthetic treatment. *Results:* We found that university-educated people were more concerned about the condition of their oral cavity; the loss
of teeth was not as extensive as for subjects with less education and were mainly treated with fixed prostheses. When evaluating the responses of the nutritional questionnaire, there were more significant differences between the male and female groups, namely: two fifths of the examined men and three fifths of women achieved a score of 28 and below thus indicating for treatment for malnutrition. Correlation between score values and selected nutritional status assessment parameters was not confirmed, nor was the relationship with BMI. There were, however, statistically significant differences when differentiated by subjects’ level of education, confirming that educational attainment has an impact on dietary choices. One significant confirmation is also the association of the number of occluding pairs (NOP) of teeth in patients not reporting difficulties or restrictions in the choice of meals. Conclusions: Nutrition is known to be a key factor in the development of various diseases. Confirmed connections are directly applicable in dentistry to make patients aware of the consequences of decisions on maintaining the state of their teeth.

Keywords: dentition, malnutrition, nutrition status, occluding pairs, questionnaire.

1. INTRODUCTION

A complete, healthy set of teeth functions as a whole, enabling mastication, phonation and aesthetics. Each tooth creates a natural, physiological contact with adjacent teeth in occlusion. The loss of one or more teeth hinders occlusion and initiates compensation mechanisms, even for teeth located far from the missing tooth. The teeth adjacent to the gap may be inclined due to loss of contact with the missing tooth with the possibility of the inclination inducing a wedge-like bone resorption due to pressure. This is often the reason for the replacement of even one tooth for prevention, in this example tertiary. Maintaining complete and especially healthy dentition is of particular importance in maintaining the quality of life by the ability to chew effectively, enabling effective mechanical digestion and thus receiving nutritionally acceptable food (Drisko et al., 2001). Several authors have agreed that tooth loss in general is caused most frequently by periodontal disease, followed by dental caries, injuries and developmental anomalies (Hayes et al., 2014; Thomson, 2004). Periodontal bone loss, tooth mobility, furcation, depth of infrabony pockets, tooth type, and tooth vitality can all affect tooth loss, in addition to others such as abutment teeth or root grooves (Dannewitz et al., 2006; Faggion et al., 2007; Muzzi et al., 2006; Pretzl et al., 2008). However, the representation of individual reasons for tooth loss varies between different age categories, with respect to gender, annual recall visits, smoking, length of support periodontal therapy, and IL-1 polymorphism (Eickholz et al., 2007; Fardal et al., 2004; Chambrone and Chambrone, 2006; Pretzl et al., 2008).

According to a systematic evaluation of the relationship between oral function and the state of dentition, the presence of 20 or fewer teeth with 9-10 pairs of occluding teeth is deemed to impair masticatory effectiveness and alter overall mastication (individual perception of the patient’s ability to chew) (Gottfredsen and Wall, 2007). In old age, dental caries, periodontal diseases, edentulism, xerostomia and oral cavity tumours are negatively involved in the oral cavity status (Drisko et al., 2001; Kassebaum et al., 2014; Singh and Papas, 2014), with edentulism being directly linked to problems with mastication and nutrition (Divaris et al., 2012). Total replacement patients have a chewing strength of 20-25% that of individuals with preserved natural teeth. The chewing ability of total dental prostheses is approximately 80% lower than that of people with intact dentition (Bandodkar and Aras, 2006). In addition, the thickness of the masseter is greatly reduced in toothless patients, thus reducing its contractile ability. This may partly explain why patients with total prostheses have difficulties in chewing hard foods. According to the study by Tsakos et al. (2010) tooth loss has a negative impact on overall food choices. The replacement of inappropriate artificial prostheses with new ones does not necessarily lead to a significant improvement in the choice and intake of food alone. Similarly, exchanging optimal removable dentures for implant-borne dentures has not led to a significant improvement in food choices or nutrient intake (Bandodkar and Aras, 2006).

A number of nutrients, particularly antioxidants, can reduce tooth loss and modulate systemic diseases by interfering with the inflammatory cascade and preventing carcinogenesis. Adults who have at least partially retained their natural teeth tend to eat more fruit and vegetables than patients with total replacement. Emami et al. (2013) confirmed that the diet of toothless subjects consists of foods low in fibre and high in saturated fats, with significant changes in the consumption of high-fibre foods such as bread, fruit, vegetables and non-starch polysaccharides. They also found that total loss of teeth was associated with low citrus consumption, low plasma levels of vitamin C, and increased serum levels of inflammatory reactants, such as e.g. C-reactive protein, IL-6, fibrinogen and factor VIII.

The objective of assessing the risk of nutritional deficiency in impaired oral health is to aid early identification and intervention thus alleviating the incidence and severity of nutritional risks and maximizing response to treatment. The type and extent of risk factors determines nutritional risks. In addition to the proven adverse effects of malnutrition on the immune status of the oral cavity, there are also direct links to this malnutrition cycle, which range from reduced nutrition to immunity to periodontal diseases and
caries processes in the oral cavity. The aim of this work was therefore to evaluate and compare the nutritional status in elderly patients in terms of the degree of preservation of dentition and prosthetic treatment via measurement of selected parameters.

2. MATERIALS AND METHODS
The study group consisted predominantly of patients over the age of 60, although younger patients with dental prosthesis were also included. The sample consisted of 67 subjects (42 women, 25 men) aged 49 to 89. The investigation was conducted from March to May 2018 during routine examinations or recall visits of patients after becoming familiar with the experiment and expressing both oral and written consent. The research plan was approved by the Ethics Committee of the Medical Faculty of Pavol Jozef Šafárik University in Košice under number 6N/2017.

Figure 1 Flowchart of patient’s enrollment and follow-up in the study.

All patients were examined extra- and intraorally using a dental probe and a mirror. The condition of the oral cavity was noted with an emphasis on the number of natural teeth, the method and quality of the prosthetic treatment, and the amount of occluding distal teeth. Subsequently, the patients completed a questionnaire on general health, satisfaction with treatment and eating habits. The questionnaire also included 8 questions from the Council of Nutrition Appetite Questionnaire (CNAQ), based on which a score was calculated expressing the risk of malnutrition. Each of the questions in the questionnaire had 5 responses (a - e) to which a score was assigned (1-5) with the final score calculated as a total thereof. The maximum score was 40, and the minimal 8. The resulting scores were evaluated as follows: 8-16 - the patient is at risk of anorexia and requires nutritional counselling for treatment recommendations, 17-28 - the patient is at risk of malnutrition and requires more frequent reassessment, > 28 - the patient is not at risk (Fig 1).

42 patients agreed to have venous blood taken for the purpose of the experiment. All of these patients were followed up in a haematology clinic for haematological diseases. Of these, four were excluded due to laboratory-proven signs of an inflammatory
response with a CRP greater than 5mg.l⁻¹, suggesting the onset of infection. After this selection, 38 patients, including 20 women and 18 men over the age of 62, were enrolled to measure biochemical parameters. Venous blood samples were sent to Medirexa.s., where the levels of albumin, prealbumin, transferrin, and also the serum level of C-reactive protein were determined by Advia 2400 (Siemens Healthineers, Germany). In addition, renal function was determined by creatinine concentration and glomerular filtration estimated from creatinine (Fig 1).

The level of agreement between the parameters was evaluated as a dichotomised score. Statistical significance of differences between groups in the compared parameters was evaluated by an ANOVA test and their association with a chi-square test. Statistical evaluation served to verify these assumptions:

1. Is the level of achieved education related to the type of prosthetic treatment of the patient, the number of retained natural teeth, or NOP as an indicator of the outcome of dental care to date?
2. Are patients with further education more often burdened with fear of dental treatment, or with the same frequency as less educated people?
3. Is there a relationship between reduced questionnairescore and biochemical parameters monitoring nutritional status (albumin, prealbumin, transferrin) in the study population?
4. Is a decreasing score related to the increasing age of patients?
5. Does a decreasing score correlate with the BMI of patients?
6. Is there a relationship between body mass index (BMI) and NOP or number of teeth?
7. Is there a relationship between decreased score and concomitantly decreased NOP in laboratory parameters monitoring nutritional status (albumin, prealbumin, transferrin) in the study group?

3. RESULTS AND DISCUSSION

Results of questionnaire survey

67 subjects participated in the questionnaire. The respondents were divided by gender and, as is clearly seen in Table 1, almost two times more women than men participated in the survey. The oldest participant at the time of the analysis was 89 years old, the youngest 49 years old. 71% of the patients were 65-80 years old. 15% of subjects were over 81 years of age and 14% were under 65 years of age. The survey also considered the highest level of education. Most subjects in the male and female groups were educated to a secondary school level, approximately one fifth in both groups were university graduates and the smallest group of subjects consisted of those with only primary education (19% of women and 12% of men) (Table 1).

When evaluating the questionnaire responses, there were more significant differences between male and female than in case of achieved education. Based on this questionnaire, it was found that three-fifths of men were not undernourished, as they reached a score of more than 28 points, with the remaining two-fifths achieving a score of 28 and below indicating a risk of malnutrition. In women, this ratio was reversed and just over two-fifths of the respondents scored higher than 28, with the remaining subjects scoring 28 and below. In none of the cases was the score lower than 17, in which case patients would be at a serious risk of malnutrition and requiring treatment (Table 1).

Table 1 Characteristics of the patients and results from evaluation.

<table>
<thead>
<tr>
<th>Age distribution (years)</th>
<th>&lt; 65</th>
<th>65 - 69</th>
<th>70 - 74</th>
<th>75 - 80</th>
<th>&gt; 81</th>
</tr>
</thead>
<tbody>
<tr>
<td>By gender</td>
<td></td>
<td>Male</td>
<td>Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>72.6 ± 8.3</td>
<td>70.9 ± 7.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>27.4 ± 3.6</td>
<td>27.8 ± 3.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>63.7%</td>
<td>37.30%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td>primary</td>
<td>secondary</td>
<td>university</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>68</td>
<td>20</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>NOP</td>
<td>0-4</td>
<td>92</td>
<td>78.6</td>
<td>21.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>more than 5</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of teeth</td>
<td>under 10</td>
<td>68</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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10-20  16  23.8
more than 20  16  33.4

Dental status
residual dentition  64  68.3
toothless  36  31.7

Fear of treatment
none  84  69
a little  8  28.6
insurmountable  8  2.4

Use of aids in oral hygiene
brush  32  7
brush and toothpaste  60  70
others  8  23

Frequency of cleaning
less than 1x  12  0
1x  40  21.4
2x  44  66.7

Q1
less than 5 years  24  11.4
more than 5 years  16  14.3
more than 10 years  8  20
more than 15 years/ don't remember  28  54.3

Q2
yes  23  14.3
no  77  85.7

Q3
yes  44  38.1
no  56  61.9

Q4
yes  8  12.2
no  92  87.8

Q5
yes  4  2.4
no  96  97.6

Q6
yes  88  88.1
no  12  11.9

Q7
yes  20  11.4
no  80  88.6

Q8
yes  25  28.6
no  75  71.4

Q9
yes  29.2  19.5
no  70.8  80.5

Q10
yes  68  85.7
no  32  14.3

Overall score
0 – 16  0  0
27 – 28  40  59
> 29  60  41

By score  < 28  > 28
albumin (g.l⁻¹)  42.4 ± 3.2  44.8 ± 2.5
transferrin (g.l⁻¹)  2.41 ± 0.36  2.69 ± 0.45
prealbumin (g.l⁻¹)  0.29 ± 0.08  0.29 ± 0.061
eGF  1.23 ± 0.35  1.24 ± 0.39
hsCRP (mg.l⁻¹)  3.5 ± 1.6  3.6 ± 1.7
Leukocytes (x10⁹.l⁻¹)  6.49 ± 1.81  6.7 ± 1.67

The lowest scores were 19 in women and 20 in men. In these cases, however, BMI pointed to normal weight or overweight, so that quantitative malnutrition could be ruled out. This was not the case for qualitative nutrition, as serum transferrin levels were reduced in male subjects (Table 1). In terms of oral hygiene, the ratio between men and women was fairly balanced with brushes and
pastes used by most subjects. Other aids such as dental floss or interdental brushes were used by only 8% of men and 21% of women. 32% of men but only 7% of women used only a toothbrush for oral hygiene, often in subjects with total replacement or extensive partial removable dentures. Thus, these figures point to the possibility that women are more concerned with oral hygiene, which may also be associated with a higher proportion of women among subjects with the highest number of preserved natural teeth in the oral cavity (Table 1). Almost all subjects were treated with some prosthetic work, with only two subjects having their teeth preserved in such a way that they did not need prosthetic treatment. 10 subjects needed prosthetic treatment, 5 of them needed fixed dentures, the remaining 5 removable ones. Patients in need of treatment with removable dentures were largely uninterested, in one case it was justified by the fact that the patient was unable to overcome the fear of a dentist and got used to toothless alveolar processes. He was able to eat with them and treatment was, in his own words, unnecessary.

Patients in need of treatment with fixed dentures were aware of their condition, recall visits were regularly made, and treatment was planned. Patients with primary education did not have fixed substitutes; most of them had total replacements, while the rest had a total replacement with a partial removable replacement. The combination of fixed and removable prosthesis was found in half of university graduates and also in three subjects with secondary education. The most common method of treatment was the use of removable dentures, whether total or partial removable, often in the combination of two total replacements, or total replacements with partial removable replacements in the opposite tooth arch. This reflects the sad reality of the number of missing teeth that cannot be replaced by a fixed substitute, and also points out that university educated people are more concerned with the condition of their oral cavity; tooth loss is not as extensive as in people with less education and is mainly treated with fixed prosthesis. Exceptions presented in the form of a university-educated individual without a single natural tooth and a prosthetic replacement. In addition, there were secondary-school educated individuals who do not need prosthetic treatment, indicating that the impact of education is significant, but not absolute.

Is the level of achieved education related to the type of prosthetic treatment of the patient, the number of retained natural teeth, or NOP as one of the indicators of the outcome of dental care so far?

Even though many patients still believe that the loss of teeth is related to age and make regular claims such as: "I'm old already, so I have removable dentures" or: "It's great for my age, isn't it?" (A patient with less than 10 natural teeth). Dental practitioners tend to nod at such claims, although they know that the oral hygiene of the elderly in Slovakia is far from ideal, there are also clear exceptions during the survey. One subject at the age of 69 had complete natural dentition, with prosthetic treatment consisting solely of crowns on the lower front teeth due to abrasion. The case was also interesting of the 80-year-old subject had 7 NOP and 28 teeth, and the 71-year-old subject with 8 NOP and 30 teeth. It should be noted that out of the eight cases where subjects present 28 and more natural teeth, there were 4 cases of university graduates and another 4 subjects with secondary education.

Four patients from these eight reported that they were afraid of visiting a dentist but could overcome it without much difficulty. Of the eight subjects, only one was male, suggesting that women are more concerned with their appearance and health. Given the significantly higher number of women in the survey, with better oral hygiene results, this ratio was expected, but it was significantly higher than would be expected from the male/female ratio. To improve the statistics, it must be said that 20 patients out of 67 had at least 20 teeth preserved (half of them were university graduates). However, only 15 patients had at least 4 NOP. The achieved education was related to the number of natural teeth and subjects with higher educational attainment had a higher tendency to retain a greater number of teeth even at the higher age, but it was not a rule that people with tertiary education had better or more natural teeth than people with secondary education. Subjects with primary education had not been treated with fixed prosthesis and had a higher tendency to wear removable replacements for aesthetic than functional reasons.

Are patients with higher education more often burdened with fear of dental treatment, or with the same frequency as less educated people?

28.6% of university-educated subjects claimed to have little fear of a dentist and could overcome it, 7% visited a dentist only when they must and were very afraid, 21.5% were afraid of visiting a dental practitioner, and 2.5% had a strong, hard-to-overcome fear. In the group of subjects with primary education, 9% had little fear and another 9% had a fear that was hard to overcome. In view of these figures, it can be said that fear of dental practitioners is more common for tertiary educated people, but the statement made by several toothless patients also needs to be taken into account: "I only have false teeth, nothing more to fear". It should also be taken into account that all subjects with primary education had at least one completely toothless dental arch and residual dentition in the second dental arch, which could only be supplemented using a removable denture. On the basis of this statement, we can conclude that in the study group, university educated people were not more afraid of dentists, nor were they more often afraid of dental practitioners, rather it may have been related to the knowledge that visiting a dentist could reveal deficiencies in their oral
hygiene. A slight fear that patients can suppress is certainly not an obstacle to dental treatment, given that four out of nine subjects with at least seven preserved NOP admitted that they felt a slight fear of visiting a dentist, but were able to overcome it and the number of remaining teeth in these subjects was above average for the study.

Is there a relationship between reduced questionnaire score and biochemical parameters monitoring nutritional status (albumin, prealbumin and transferrin) in the study population? The relationship between score values and serum albumin levels was not demonstrated as all subjects examined had a level within the physiological range. Similarly, there was no correlation between score results and albumin levels using the Pearson correlation coefficient (Fig 2).

The correlation between serum transferrin levels and score was not observed in subjects with a score less than or equal to 28 (Fig 3). However, in subjects with a score above 28, we observed a correlation at statistical significance (p <0.05) (Fig 3). There was also found to be a correlation between increasing questionnaire score and the serum transferrin level of the subjects, as the male subject
with the lowest score (20) had a reduced transferrin level. The ratio of reduced transferrin levels in subjects with scores below 28 to subjects with a higher score was 7.5. Other individuals had a transferrin concentration in the normal range. The correlation between score and serum prealbumin was not observed in our research group (Fig 4), as nearly all patients had a prealbumin concentration in the normal range, with minimal differences when compared to physiological range.

Figure 4 Correlation of prealbumin values with a score of 28 and lower and higher than 28.

Is a decreasing questionnaire score related to the increasing age of patients?
A decreasing score is slightly correlated with the increasing age of patients. This means that the higher the age of the respondents, the lower the score, although this relationship did not reach statistical significance (Fig 5).

Figure 5 Correlation of age with score, and BMI values with score.

Does a decreasing score correlate with BMI of patients?
The correlation between decreasing score and decreasing BMI was not confirmed in our research group (Fig 5). This points out that some patients at risk of malnutrition can instead have a high body mass due to a high-calorie diet with poor nutrient ratio and a lack of important micro- and macronutrients. The absence of correlation between BMI and questionnaire score (Fig 5) is consistent with the results published by Perera and Ekanayake (2012), where 20% were reported below 18.5 and 12% had a value of BMI above 25, with no connection between tooth loss and overweight or obesity. The connection between the number of missing teeth and BMI
was also not found in the Brazilian study of de Andrade et al. (2009). To the contrary, Sheiham’s study (Sheiham et al., 1999), pointed out that patients with low residual teeth, often without dentures, tend to be overweight. The logically expected correlation between tooth loss and BMI has not been confirmed and despite clearly decreasing mastication ability, no weight loss has occurred.

Is there a relationship between BMI and NOP or number of teeth?

Perera’s study (Perera and Ekanayake, 2012) confirmed that effectiveness in chewing is associated with NOP, and that their lower number is associated with lower food intake, suggesting that NOP is a more important factor than the number of natural teeth in determining nutritional risk. These claims are also supported by Sahyoun et al. (2003), who found a positive correlation between the numbers of teeth, in particular NOP, and the nutritional status of individuals. This was determined based on dietary quality, serum nutrient levels and inverse relationships between individuals with one to four NOP and BMI based on a lower Healthy Eating Index score. People without back teeth consumed less fruit and vegetables and their diet was less varied. The results were independent of age, gender, ethnicity, education, poverty and smoking index.

![Figure 6](image.png)

**Figure 6** Correlation of BMI values with NOP and BMI with number of residual teeth.

It is generally known that people with fewer occluding teeth avoid fibrous food, including meat, crunchy foods including vegetables, and dry, solid foods. These conclusions were also reached by Kumar et al. (2012), Lee et al. (2004) and Mojon et al. (1999). Those who wear common total prostheses have been shown to have significantly lower effectiveness in chewing than those with full natural dentition. Toothless patients with mandibular, implant-supported restorations show higher effectiveness in chewing than patients with total restorations in both dental arches. Patients with implants in the mandible had comparable effectiveness in chewing to toothless patients with fixed implant bridges in both arches. The efficacy of total dentition could not be achieved by any of the aforementioned methods. This may be associated with loss of periodontal receptors and alteration of the slide (Müller et al., 2012).

BMI values are similar to those both with and without natural teeth, and none of the three studies found a significant association between tooth number and BMI. Similarly, in our study, there was no significant correlation between tooth number and BMI, or NOP and BMI (Fig 6).
Is there a relationship between decreased score and concomitantly decreased NOP in laboratory parameters monitoring nutritional status (albumin, prealbumin and transferrin) in the study group?

A close link between nutritional status and oral health has been demonstrated by Samnieng et al. (2011) and Samnieng (2015). A lower number of natural teeth were associated with malnutrition in these subjects. In addition, they found that NOP and chewing strength are key determinants of chewing performance and point out that they are better indicators of malnutrition risk than total number of teeth. However, using the Mini Nutritional Assessment questionnaire, BMI was not used to address or evaluate nutritional status. Significantly lower BMI and serum albumin levels in patients with poor oral status were demonstrated by Mojon et al. (1999), on patients from Switzerland with an average age of 85 years. Approximately two thirds of subjects were dependent on the care of medical staff and half had a BMI below 21, or a serum albumin level of less than 33g.l⁻¹. Patients with no or inadequate prosthesis were most often malnourished. The condition of the oral cavity was more often unsatisfactory in patients completely reliant on the care of the staff, but inadequate oral cavity status was also found in patients who were only partially reliant. Suzuki et al. have found that the factors affecting the overall energy intake of subjects in the senior group were body weight and the number of distal teeth (Suzuki et al., 2005). In men, there was a significant difference between those who had 5 or more distal teeth and those who had 4 or fewer. Those with five or more distal teeth had higher levels of glucose and vitamin B1 in serum, differences in total energy intake, protein, sugars and, above all, fibre. Differences in serum iron and vitamin B1 were noted in the female group. The results of this study, however, show that educational attainment also has an impact on dietary choices, as reflected in the differences between serum albumin concentrations in patients with a primary school education and those with a secondary school education without graduation (p = 0.024) as well as secondary school education without graduation versus university graduates (p = 0.043). Similarly, significant differences between the same groups were found for prealbumin at p = 0.046 and p = 0.020.

Interestingly, even comparing the prosthetic status of patients differentiated based on their questionnaire score did not significantly differ (χ² =0.23, df =2, p=0.891). Other issues were also investigated, such as limiting the possibility of eating due to dental prosthesis and changing the way they eat after prosthetic treatment (Q2 and Q8, Table 1). Nor were there any differences between patient groups differentiated by score (χ² =0.000, df =1, p=1.000 and χ² =0.248, df =1, p=0.619 respectively). Likewise, in differentiation according to prosthetic status, the differences between the groups were not significant (χ² =1.392, df =2, p=0.499 and χ² =2.758, df =2, p=0.252). However, significant differences (p≤0.001) were observed between patients responding negatively to dietary restrictions (Q2) according to their prosthetic status except for the comparison between patients with no prosthetic replacement and those with partial replacement. Furthermore, NOP was higher in patients reporting no problems.

4. CONCLUSION

Gathering comprehensive patient data is both a routine and important step in the assessment of nutritional risk. In addition to taking a medical history, diet and nutritional risk assessment, additional questions on oral health and nutrition are essential. Comparison of values of nutrition status markers, educational attainment and the degree of preservation of dentition and prosthetic treatment in elderly patient revealed some findings. For example, the link between education levels and dietary choices has been confirmed. Significant differences were found in patients on the issue of limiting food intake due to the presence of dental replacements, whereas the number of occluding pairs is an important element in overall satisfaction and patients’ freedom in food selection.

Informed Consent

Potential participants were enrolled the study after signing the informed consent.

Conflict of Interest

None of the authors has financial/commercial conflicts of interest with the published data.

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Ethical approval for the study protocol

The study was approved by the Ethics Committee of the Medical Faculty of Pavol Jozef Šafárik University in Košice under number 6N/2017.
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