Acta Scientiarum

http://periodicos.uem.br/ojs
ISSN on-line: 1807-8648
Doi: 10.4025/actascihealthsci.v44i1.53676

Relationship between tooth loss, nutritional status and consumption of macro and micronutrients in elderly people from southern Brazil

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ABSTRACT. Maintaining a functional natural dentition plays an important role in keeping a satisfactory nutritional status. The aim of this study was to evaluate the relationship between oral health conditions determined by the presence of edentulism and the number of missing teeth, nutritional status and consumption of nutrients by the elderly. This cross-sectional study comprised 494 independent elderly of both genders, over 60 years of age, registered at the Brazilian public health service in Londrina, southern Brazil. The data collection included: oral examinations; anthropometric measurements by calculating the Body Mass Index (BMI); analysis of food consumption based on a multiple pass 24-hour dietary recall and a food intake frequency questionnaire; and structured interviews to obtain sociodemographic information. Multiple linear regression, the Fisher's Exact test, chi-square and Mann-Whitney tests, were applied at a 5% significance level. The prevalence of edentulism was 47.3%; this predominated in females, age group from 65 to 74 years, low education level and low/medium economic classification. A larger number of underweight and fewer number of overweight elderly were recorded among the edentulous versus dentate participants (< 0.0001). Significantly lower consumption of several nutrients, as well as fruit, was recorded among the edentulous group. In particular, carbohydrates, vitamins (B1, B9 and C), and the majority of the minerals studied were associated with a larger number of missing teeth. In conclusion, tooth loss was associated with the food consumption pattern of some macro- and micronutrients and the nutritional status of the Brazilian elderly.

Keywords: tooth loss; dietary pattern; nutritional status; older people.

Received on May 5, 2020.
Accepted on April 21, 2021.

Introduction

The growth in the elderly population, in absolute and relative terms, is a worldwide phenomenon. According to the World Health Organization projections, the elderly population will have reached 2 billion people by 2050, equivalent to 22% of the world population (World Health Organization [WHO], 2015). The Brazilian Institute of Geography and Statistics estimates show that, in Brazil, the elderly population would rise from 14.3% in 2020 to 32.2% of its total population by the year 2060 (Instituto Brasileiro de Geografia e Estatística [IBGE], 2019). Among the main challenges faced as a result of changes in the Brazilian population structure are the demands placed on its healthcare system (Simões, 2016).

Results of nationwide epidemiological surveys have shown the serious oral health situation among the Brazilian elderly (Brasil, 1988; 2004; 2012). The latest survey presented an alarming scenario in which 90.1% of elderly individuals aged 65 to 74 years had no functional teeth in at least one arch (Brasil, 2012). Changes in the oral health of the elderly, such as tooth loss, can increase the chances of individuals having a worse quality of life (Ribeiro et al., 2016). In a prior research, Zelig et al. (2019) reported that tooth loss becomes a challenge for the elderly, because in addition to being associated with adverse changes in food intake, it can affect socialization, which can further influence their quality of life. Due to masticatory difficulty, some participants mentioned avoiding nutrient-rich foods and that they have adopted inadequate coping

strategies, such as avoiding or reducing their frequency of smiling, talking, and eating in public.

Dental condition can have a major impact on food choices and the intake of important nutrients (Kossioni, 2018). Edentulous individuals tend to consume fewer nutrients than dentate ones, in relation to the ideal recommendations (Ervin & Dye, 2009). The elderly tend to change their eating habits as a result of reduced masticatory efficiency, occurring primarily due to edentulism (De Marchi, Hugo, Hilgert, & Padilha, 2012). These individuals tend to prefer soft and processed foods, and avoid fruits, vegetables and meats considered difficult or impossible to chew, resulting in a lower intake of vitamin C, calcium, non-starch polysaccharides and proteins (Marcenes, Steele, Sheiham, & Walls, 2003; Hung, Colditz, & Joshipura, 2005).

Oral health is an important factor for improving nutritional status and tooth loss is closely associated with nutrition and cardiovascular diseases. Periodontal disease and tooth loss can have an adverse impact on systemic health, which can lead to progressive atherosclerosis and cardiovascular disease. In addition, tooth loss leads to decreased masticatory capacity and severe tooth loss decreases food intake, such as fruits and vegetables, decreasing the serum levels of nutrients such as vitamin C and carotene that have antioxidant effects. Its adequate intake is necessary for the prevention of many diseases, including the cardiovascular one (Shiga et al., 2019).

Oral and general health are interrelated, especially in elderly people (Brasil, 2012). Some studies have evaluated the association between partial or total loss of teeth and low weight and obesity in the elderly, and reduced consumption of nutrients (Nakamura et al., 2016). However, the association between the elderly tooth loss, Body Mass Index (BMI) and macro and micronutrient consumption in the same study has been little explored.

Following the global and national trend, in Londrina, southern Brazil, the elderly represent 12.1% of the total population. Thus, the aim of this study was to evaluate the prevalence of edentulism and the number of missing teeth and its relation with nutritional status and macro and micronutrient intake in independent elderly enrolled in Primary Healthcare Units (PHUs).

Methodology

Design and eligibility criteria of the study population

This cross-sectional, observational study was part of a larger thematic project: the EELO Project - Brazilian acronym for 'Study on aging and longevity', carried out by an interdisciplinary team from the University of Northern Paraná (UNOPAR), in partnership with the Departments of Health and of the Elderly in Londrina, a city in southern Brazil.

The sample for the EELO project was obtained from a total of 43.610 elderly registered in 38 Basic Health Units (BHU) in the urban area of Londrina. The minimum sample size of 396 was defined based on the formula proposed by Barbetta (2010) considering a 95% confidence interval and a 5% sampling error. In an attempt to provide an opportunity to a greater number of individuals to perform the health assessments, the coordinators of the project decided to extend the sample to 520 elderly.

Stratified random sampling was used considering the municipality's five regions (15% from the central, 27% from the northern, 23% from the southern, 19% from the eastern, and 16% from the western). Participants were randomly selected based on the individual registers in the Family Health Strategy program.

In order to perform the field work, the elderly were divided into small groups and were transported from their respective health units to the UNOPAR Research Center for three days in the same week. Data collection was performed within 18 months and included structured interviews and a set of 48 different evaluations. As some participants did not attend every day, the final sample of the present study consists of 494 individuals who participated in both oral and nutritional assessments.

The study included elderly ⩾ 60 years old, of both genders, living independently, classified at level 3 or 4 as proposed by Spirduso (2005), which means that they were able to perform basic activities of daily life.

Data Collection

Identification of sociodemographic characteristics

Sociodemographic information was obtained from the responses given by the elderly individuals to a structured questionnaire, which comprised the following variables: gender (male/female), age (60 to 64 years / 65 to 74 years / ⩾ 75 years), living status (lives with others/ alone), schooling (⩽ 4 years of education / >4 years), and economic class (A1, A2, B1, B2, C1, C2, D and E). The definition of the economic classes was based

on the Brazilian Economic Classification criterion (Associação Brasileira de Empresas de Pesquisa [ABEP], 2018). For statistical purposes, classes were grouped into the following categories: 'upper' (A and B), 'middle' (C) and 'lower' (D and E).

Assessment of oral conditions

Oral health was evaluated using the DMFT index (decayed, missing and filled permanent teeth), according to the diagnostic criteria defined by the World Health Organization (World Health Organization [WHO], 2013). The number of missing teeth was obtained by the sum of codes 4 and 5 of the index and consisted of a discrete variable from 0 to 32. Individuals who did not have a single natural tooth in both arches were regarded as edentulous. A single examiner performed the clinical examinations.

Anthropometric evaluation

Body weight was measured on a digital scale (Filizola model ID 110), to the nearest 0.1 kg, and height was measured using a wooden stadiometer with an accuracy of 0.1 cm, according to the procedures described by Freitas et al. (2016). The body mass index (BMI) was calculated based on these measurements and the relationship between body weight in kilograms (kg) and height in square meters (m). The elderly were classified according to the following cut off points: underweight (BMI $\leqslant$ 22 kg m^{-2}), normal weight (22 < BMI < 27 kg m^{-2}), and overweight (BMI $\geqslant$ 27kg m^{-2}).

Food consumption

The evaluation of dietary intake was performed using a multiple 24-hour dietary recall and food frequency survey methods. The recall was used for quantifying the foods consumed on the day prior to the interview. The quantities were recorded using previously standardized portion sizes, which served to estimate the quantity consumed.

Twelve dietitians were trained to collect and analyze the data. Interviews were conducted on three different days, one on the weekend and two midweek. The interviews were conducted to record the food consumed in meals, following the order of daily meal consumption, and using a photo album with portion sizes and pictures of food as visual aids. The types of food, quantity consumed and form of preparation were recorded. The food portion sizes were quantified in grams or milliliters.

Dietary data were processed and analyzed by Avanutri online software, used routinely because it includes most of the fresh and processed foods consumed by the Brazilian population. The dietary variables studied were total calorie intake (kcal/day), proteins (g day^{-1}), carbohydrates (g day^{-1}), total lipids (g day^{-1}), saturated (g day^{-1}), monounsaturated (g day^{-1}), polyunsaturated (g day^{-1}) and cholesterol fats (mg day^{-1}), dietary fiber (g day^{-1}), vitamins A, B_{12}, D, E and folic acid (µg day^{-1}), and vitamins B_1, B_2, B_5, B_6, C (mg day^{-1}), as well as minerals such as calcium, phosphorus, magnesium, iron, zinc, manganese and potassium (mg day^{-1}), and copper, iodine and selenium (µg day^{-1}). The total caloric intake obtained through the consumption of macronutrients was expressed in kcal/day. The recommendations made in the *Dietary reference intake table* (Institute of Medicine, 2005) were used as the parameter for appropriate consumption.

The dietary frequency questionnaire, considering the Brazilian eating habits, which was validated by Furlan-Viebig & Pastor-Valero (2004), was used to verify consumption frequency. This enabled identification of customary dietary patterns, and hence the exposure of the studied population to dietary risk factors.

The questionnaire consists of a list of 98 foods, arranged in groups based on similar dietary characteristics, and comprises nine categories of consumption frequency responses (never or < than 1 x / month; 2 to 3 x / month; 1 x / week; 2 to 4 x / week; 5 to 7 x / week; 1 x / day; 2 to 3 x / day; 4 to 6 x / day; > than 6 x / day). For the present study, only the number of portions of the following food groups was considered: breads, cereals and root vegetables; fruits and natural juices; vegetables and greens; meat, fish and eggs; legumes; milk and milk products; oil/fat, adopting the Food Pyramid as a reference.

Statistical analysis

All the analyses were performed with the *Statistical Package for Social Sciences* program version 20.0 (IBM SPSS®, Armonk, NY, USA), adopting a 95% confidence interval and a significance level of 5% ($p < 0.05$) for all the tests.

Initially, the Shapiro-Wilk test was conducted to test normality. The description of the results was expressed as frequency (absolute and relative) or mean (M) and standard deviation (SD). The Mann-Whitney and chi-square test and Fisher's Exact test were performed to analyze the differences between dentate and edentulous elderly subjects. Multiple linear regression analysis was performed to evaluate the relationship between the number of missing teeth and the intake of nutrients per day. Each nutritional variable was used as a dependent variable. Independent variables included the number of missing teeth, gender, age and nutritional status.

Results

Among the independent elderly studied, the prevalence of edentulism was 47.8%. Those who were dentate had a mean of 25.4 (8.4) missing teeth. Regarding their nutritional status: 10.7% were underweight, 35% were eutrophic and 54.3% were overweight.

Statistically significant differences were observed between edentulous and dentate participants in relation to certain sociodemographic characteristics (Table 1). Edentulism was predominant in females (71.6%), aged 65-74 years (56.8%), of low education level (90.3%) and low/medium economic classification (90.7%). Edentulism was also associated with the elderly nutritional status (p = 0.001). A larger number of underweight (15.7%) and fewer number of overweight (47.9%) individuals were recorded among the edentulous versus dentate subjects (respectively 6.2% and 60.1%).

Table 1. Relationship between edentulism and sociodemographic characteristics and nutritional status in the elderly people (N=494).

Variables	Dentate	Edentulous	p-value
	n (%)	n (%)	
Gender			
Female	160 (62.0)	169 (71.6)	**0.028**‡
Male	98 (38.0)	67 (28.4)	
Age in years			
60 a 64	89 (34.5)	31 (13.1)	
65 a 74	137 (53.1)	134 (56.8)	**< 0.0001**ᵗ
75 and +	32 (12.4)	71 (30.1)	
Living condition			
With others	176(68.2)	144 (61.0)	0.095‡
Alone	82 (31.8)	92 (39.0)	
Schooling in years			
> 4	185 (71.7)	213 (90.3)	**< 0.0001**‡
⩽ 4	73 (28.3)	23 (9.7)	
Economic class			
upper	60 (23.3)	22 (9.3)	**< 0.0001**ᵗ
middle	165 (64.0)	154 (64.8)	
lower	33 (12.8)	61 (25.8)	
Nutritional status			
Low weight	16 (6.2)	37 (15.7)	
Normal weight	87 (33.7)	86 (36.4)	**< 0.0001**ᵗ
overweight	155 (60.1)	113 (47.9)	

ᵗ Chi-square test ‡ Fisher's Exact test.

There was a significant difference in the intake of some macro- and micronutrients between the dentate and edentulous elderly, in which, lower intake was observed among the edentulous ones (Table 2). Only in the intake of polyunsaturated (p = 0.104) and monounsaturated (p = 0.066) fats, cholesterol (p = 0.302), vitamins B12 (p = 0.070) and D (p = 0.096), iodine (p = 0.267) and selenium (p = 0.053) no statistically significant difference was observed.

As shown in Table 3, after adjusting for gender, age and BMI the number of missing teeth was significantly associated with total energy and protein intake (p < 0.0001); lipids (p = 0.002); three vitamins: vitamin B1, B9 and C; and six minerals: calcium, phosphorus, magnesium, zinc, potassium and iodine, pointing out that the elderly with fewer teeth consumed fewer nutrients. The mean intake of the nutrients in the participants who had fewer teeth was significantly lower than that of the elderly with more teeth.

Table 2. Relationship between edentulism and nutrient intake by the elderly people (N=494).

Nutrients	Dentate		Edentulous		p-value*
	Mean	SD	Mean	SD	
Total Calories[d]	1578.99	510.14	1415.37	431.60	< 0.0001
Macronutrients					
Protein [a]	73.23	31.03	64.63	24.84	< 0.0001
Carbohydrates [a]	200.53	69.77	182.59	59.91	0.005
Lipid [a]					
Fatty acids	53.46	23.33	47.15	19.73	0.002
Saturated [a]	15.96	7.70	14.29	6.47	0.022
Polyunsaturated [a]	8.08	4.39	7.47	4.26	0.104
Monounsaturated [a]	15.13	13.77	13.37	13.14	0.066
Cholesterol[a]	193.57	119.74	182.54	109.08	0.302
Dietary fibre [a]	13.13	6.32	11.73	5.26	0.029
Micronutrients					
Vitamins					
Vitamin A[b]	669.90	1381.78	528.18	896.36	0.024
Vitamin B12[b]	5.52	18.60	4.67	13.51	0.070
Vitamin D[b]	3.24	4.85	2.74	2.51	0.096
Vitamin E[b]	10.74	6.33	9.50	6.03	0.008
Folic acid [b]	111.97	81.52	94.98	69.59	0.005
Vitamin B1[c]	1.45	1.36	1.25	0.81	0.002
Vitamin B2[c]c	1.13	0.78	1.02	0.69	0.016
Vit. B5[c]	2.62	1.37	2.29	1.17	0.001
Vitamin B6[c]	0.97	0.51	0.79	0.40	< 0.0001
Vitamin C[c]	100.56	105.46	67.16	61.30	0.001
Minerals					
Calcium [c]	472.48	240.12	427.38	220.12	0.025
Phosphorus [c]	808.06	310.48	725.91	274.67	0.002
Magnesium [c]	177.39	75.29	158.44	63.38	0.004
Iron [c]	10.65	4.73	9.48	4.25	0.006
Zinc [c]	8.81	7.27	7.59	5.18	0.010
Manganese [c]	1.61	0.88	1.36	0.66	0.001
Potassium [c]	1747.42	748.28	1531.01	658.79	< 0.0001
Copper [b]	1.14	2.05	0.93	1.21	0.001
Iodine[b]	42.17	34.17	39.37	33.81	0.267
Selenium [b]	61.37	40.69	53.18	27.43	0.053

[a] (g 1000^{-1} kcal); [b](µg 1000^{-1} Kcal;) [c](mg 1000^{-1} Kcal); [d](kcal kg^{-1}) *Mann Whitney test.

Table 3. Relationship between nutrient intake and the number of missing teeth and the BMI of the elderly people (N=494).

Dependent variables* (per day)	Number of missing teeth	
	Std Coef. [i]	*P value*
Total Calories[d]	- 0.09	0.048
Macronutrients		
Protein [a]	- 0.07	0.115
Carbohydrates [a]	- 0.98	0.040
Lipid [a]	- 0.07	0.142
Fatty acids [a]		
Saturated	- 0.04	0.331
Polyunsaturated	0.02	0.605
Monounsaturated	- 0.01	0.696
Cholesterol	0.00	0.998
Dietary fibre [a]	- 0.05	0.244
Micronutrients		
Vitamins		
Vitamin A[b]	- 0.02	0.565
Vitamin B12[b]	0.03	0.521
Vitamin D[b]	- 0.06	0.182
Vitamin E[b]	- 0.04	0.451
Folic acid [b]	- 0.11	0.021
Vitamin B1[c]	- 0.12	0.021
Vitamin B2[c]	- 0.03	0.580
Vitamin B5[c]	- 0.01	0.794
Vitamin B6[c]	- 0.03	0.534
Vitamin C[c]	- 0.09	0.049

Dependent variables* (per day)	Number of missing teeth	
	Std Coef. [i]	*P value*
Minerals		
Calcium [c]	- 0.14	0.005
Phosphorus [c]	- 0.09	0.050
Magnesium [c]	- 0.09	0.049
Iron [c]	- 0.05	0.313
Zinc [c]	- 0.10	0.042
Manganese [c]	- 0.02	0.650
Potassium [c]	- 0.09	0.046
Copper [b]	- 0.04	0.352
Iodine [b]	- 0.11	0.033
Selenium [b]	- 0.01	0.777

[a] (g 1000^{-1} kcal); [b](µg 1000^{-1} Kcal;) [c](mg 1000^{-1} Kcal); [d](kcal kg^{-1}) [i] Standardized coefficient *Multiple linear regression.

As demonstrated in Table 4, the consumption of fruit was higher among dentate elders (p = 0.040).

Table 4. Relationship between edentulism and mean intake of food by the elderly people (N=494).

Food group	Dentate		Edentulous		p-value[‡]
	Mean[t]	SD	Mean[t]	SD	
Breads, cereals and tubers	4.67	1.98	4.60	1.98	0.706
Fruits	1.95	1.06	1.76	1.06	0.040
Vegetables and legumes	2.53	1.36	2.44	1.35	0.517
Meat and its products	3.28	1.21	3.28	1.21	0.842
Milk and its products	1.85	1.85	1.63	1.84	0.178
Oil and Fat	2.42	1.34	2.24	1.27	0.182
Juices	0.35	0.58	0.34	0.69	0.340

[t]Mean number of portions consumed per day. [‡]Mann -Whitney test.

Discussion

The influence of tooth loss on food consumption patterns can compromise the overall health and quality of life of the elderly (Marina, Ariga, Ganapathy, & Mallikarjuna, 2019). The present study identified a high prevalence of tooth loss, total or partial, among the elderly surveyed and also, showed how this oral health condition can negatively impact their nutritional profile. In 2020, Zelig et al. conducted a systematic review and meta-analysis to evaluate associations between tooth loss and nutritional status. They evaluated 71 articles, and the authors mention that older adults who were edentulous or had no functional dentition were 21% more likely to be at risk of malnutrition or malnutrition compared to those who were dentate or had functionally adequate dentition. The authors also mentioned that more studies should be conducted, mainly cohort studies, as these are adequate to adjust for confounding factors and will provide a better estimate of the true effect.

Three dietary factors can occur during the aging process, anorexia, obesity and food neophobia. These factors may cause malnutrition in elderly people with oral health problems (Antoniadou & Varzakas, 2020).

In relation to nutritional status, the data obtained in this study showed a statistical association between edentulism and alterations in BMI, with a higher percentage of low weight edentulous versus dentate elderly. Previous studies conducted with British (Tsakos, Herrick, Sheiham, & Watt, 2010) and Brazilian (Nakamura et al., 2016) elderly participants also reported a higher risk of low weight for edentulous elderly, compared to those with 10 or more teeth. Some aging processes, such as hormonal changes, reduced glucose tolerance and elevated levels of insulin, reduced digestive ability, chronic diseases, gastrointestinal problems, malabsorption syndromes, neurological disorders, depression and other psychological problems, lack of social life, polypharmacy, dysphagia, senses deprivations such as taste, smell and vision, can cause weight loss, anorexia and loss of appetite, as they make feeding difficult (Francisco, Assumpção, Borim, & Malta, 2019; Antoniadou & Varzakas, 2020).

It must be clarified that the literature addressing the relationship between the oral health status of independent elderly persons and the nutritional status is conflicting. Other studies found that dentate elderly individuals with fewer than 21 teeth and those that were edentulous, even if rehabilitated with complete dentures, were more likely to be obese (Peruchi et al., 2016). Methodological variation and the multifactorial nature of food choices may be responsible for this, due to confounding factors and adverse effects present in older people (Kossioni, 2018).

The reluctance to eat new foods, also called food neophobia, is related to senior wearing dentures, living alone and shorter education, causing a barrier to the consumption of organic, nutritionally and genetically modified foods, foods that were especially developed for the elderly (Antoniadou & Varzakas, 2020).

The World Health Organization [WHO] (2019) recommends that a balanced diet is essential for achieving the right to health. In this study, the elderly with tooth loss had an unsatisfactory nutritional pattern based on their lower consumption of macro- and micronutrients; this is in accordance with the findings of previous studies, despite the distinct methodologies used (Tsakos et al., 2010; De Marchi et al., 2011). Although Yoshihara, Watanabe, Nishimuta, Hanada, & Miyasaki (2005) used a smaller sample, they also reported that the consumption of minerals (potassium, phosphorus, magnesium and iron), vitamins (E, B1, B2, B6, niacin, folic acid and pantothenic acid) and vegetables, was significantly lower in the elderly who had a fewer number of teeth. In contrast, the research by Ervin and Dye (2009) showed that oral health was not associated with kilocalories, fiber, vitamin B6, folic acid, iron, magnesium, phosphorus or potassium.

Edentulous individuals presented significantly lower rates of consumption of folic acid (vitamin B9 or folate), compared with the elderly who had more teeth. It is worth noting that the intake of both groups was well below the recommended level. These lower rates may be explained by the difficulty in chewing tougher foods, such as cereals, and the absence of important foods in the daily diet. Folic acid is found in beans, oranges, almonds, cereals and soybeans, among others, and its deficiency can result in cognitive impairment, anemia, depression and even memory disorders (Cursi, 2018). According to Tsakos et al. (2010), tooth loss is an early marker of potential decline in aged individuals.

The edentulous participants also demonstrated borderline values of Vitamin B1, possibly justified by the fact that this vitamin is present in foods such as nuts and grains. Low levels of Vitamin B1 are associated with higher insulin resistance levels and carpal tunnel syndrome, and contribute to the decline in the immune function. Vitamin B1 intervenes in carbohydrate metabolism, ensuring energy production, which modulates cognitive processing, especially in cells. The association between higher thiamine intake and better cognitive function has been reported in the literature (Garcia, Ortega, Sobaler, & Ortega, 2018). A cross-sectional study by Gaewkhiew, Sabbah, and Bernabé (2019) evaluated 788 elderly people living in the province of Phetchaburi, Thailand. The authors found that participants who had functional dentition were 61% less likely to be underweight than participants without prothesis or functional dentition, after adjusting for socio-demographic data, trends, chronic diseases and due total intake. In addition, patients with functional dentition dissipating a higher intake of fibers and thiamine (vitamin B1) explain a small part of the association between functional dentition and low weight.

As shown in this study, there is a reduction in the consumption of minerals, in elderly people with total and partial tooth loss, including iron and iodine. Iron is a necessary mineral in the neuron myelination process and neurotransmitter synthesis and its deficiency has been associated with decreased concentration, reasoning, success rate, performance, memory and calculation. Iron supplementation improves cognitive ability. Iodine is necessary for brain and mental development (Garcia, et al.,2018).

Longitudinal studies show that patients who restrict their food intake because of reduced masticatory function have loss of weight and loss of muscle mass (Cursi, 2018), and rapid weight and muscle loss lead to reduced mobility, increasing the likelihood of serious falls. Reduced food intake, together with a decline in the ability of the gastrointestinal tract to function correctly, leads to the deficient intake of micronutrients, such as calcium and vitamin D, as well as the development of osteoporosis, and increased tooth loss and alveolar bone resorption (Marcenes et al., 2003; Cursi, 2018).

Nutrient intake, especially protein, tends to decrease with aging, which may be due to impaired oral health, low chewing function, changes in the elderly's life situation and a decrease in their physical function (Bomfim, Souza, & Corrente, 2017). Protein intake was above the recommended levels among the elderly in this study, and may be justified by the change in social structure and a cultural issue in this population that generates the need for this consumption.

There are reports in the literature that claiming that edentulism impacts the general health of the patient, by greatly lowering his/her consumption of fruits and vegetables, as well as fiber and carotene. This leads to an increase in cholesterol levels from the intake of saturated fats, which not only cause a greater prevalence of obesity, but may also increase the risk of cardiovascular diseases and gastrointestinal disorders (Garcia et al., 2018). To Holmlund, Holm, and Lind (2010), the number of teeth is a predictor of cardiovascular mortality.

In this study, low fiber consumption was associated with the elderly being edentulous, in agreement with previous studies (Marcenes et al., 2003; Hung et al., 2005). Fruit intake was also significantly lower in edentulous individuals than in those with functional dentition (Ervin & Dye, 2009). The literature suggests some explanations for this: edentulous individuals and people with compromised masticatory function prefer processed foods, and avoid fruits and vegetables, considered difficult or impossible to chew (Gondivkar et al., 2019), thus resulting in a low intake of the nutrients important for promoting a healthy life.

Masticatory function is one of the oldest and most important activities, a vital factor for survival and quality of life (Ahn-Jarvis & Piancino, 2020), maintaining masticatory function, grip strength, preventing cancer, not smoking, are important to prevent malnutrition (Okamoto, Amano, Nakamura, & Yanagi, 2019). Therefore, maintaining good oral health is equivalent to maintaining optimal nutrition (Ahn-Jarvis & Piancino, 2020). Considering the high prevalence of toothless elderly, the results of the present investigation highlight the importance of ensuring adequate dental care for the entire population, as a measure imperative to increasing the quality of life of future generations. The study showed that there is a relationship between oral health and compromised intake of macro- and micronutrients. Lastly, these results also emphasize the need for multidisciplinary care in meeting the needs of the population by promoting health and reducing the prevalence of dental/nutritional problems.

The findings of this study had some limitations, especially considering that it was a cross-sectional study; therefore, causality cannot be inferred. It must also be considered that the nutritional epidemiology such as the 24-hour dietary recall may not provide a complete picture of what is being eaten on a routine basis and the food frequency questionnaire has been criticized because the elderly people may not recall exactly what they have eaten over a period of time. The use of the two methods together was one way of minimizing their individual weaknesses.

Moreover, another possible limitation was the sample selection, which involved only elderly who were enrolled in Basic Health Units. Thus, the results should not be generalized to other elderly populations, given the particular low socioeconomic level of this sample. Further research is needed to confirm these findings in diverse elderly populations.

Conclusion

This study showed a high rate of edentulism and extensive tooth loss in the elderly population studied. It highlighted the association of these oral health conditions with the underweight individuals and with a lower consumption of macro- and micro- nutrients by the elderly.

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