Oral Health-Related Quality of Life and Nutritional Status

J. A. Gil-Montoya, DDS, PhD; C. Subirá, MD, DDS, PhD; J. M. Ramón, MD, PhD; M. A. González-Moles, MD, DDS, PhD

Abstract

Objectives: *This study examines whether oral health-related quality of life (OHRQoL) is associated with malnutrition risk in the elderly.* ***Methods:*** *A cross-sectional study was designed using a representative sample of Spaniards over 65 years old. Data on sociodemographics and oral health status were gathered by interview and examination. Oral health-related quality of life was evaluated using the Geriatric Oral Health Assessment Index (GOHAI), and malnutrition risk using the Mini Nutritional Assessment (MNA).* ***Results:*** *The final sample included 2,860 elderly, 41.7 percent males and 58.3 percent females, with a mean age of 73.7 ± 6.8 years. Mean GOHAI score was 52.1 ± 7.2, with 70.7 percent of the sample needing oral health care according to this index. The mean MNA score was 24.0 ± 3.31; 3.5 percent of the elderly were malnourished, 31.5 percent were at risk of malnutrition, and 65.0 percent were considered adequately nourished. A strong association was found between mean GOHAI and MNA scores.*

Key Words: oral health, elderly, malnutrition, quality of life, GOHAI, MNA

Introduction

Malnutrition in the elderly has an evident impact on their general health and quality of life (1). Psychosocial problems associated with aging, including multiple disease states and polypharmacy, are among the primary factors associated with malnutrition risk (2,3). Other more specific factors such as mental disorders and oral–facial diseases have also been proposed as risk factors of malnutrition, although their role is controversial and more complex (4). Some studies report that oral health has an impact on food choice and on the intake of key nutrients, causing various nutritional problems (5-7). Other studies indicate that edentulous patients with no, or only one, prosthesis (upper or lower) experience more difficulty in chewing solid food, placing them at a greater risk of malnutrition (4). Inadequate dental status and folate intake in the elderly has been reported to be independent predictors of mortality at 6 years, at least in women (8).

It is known that the self-rating of oral health, perceived needs, and the impact of oral health on quality of life are not always closely correlated with clinical dental findings in the elderly (9). Furthermore, Locker and Gibson recently showed (10) that half of the subjects who described their oral health as only poor or fair claimed to be satisfied with their oral health. Therefore, the objective measurements applied in the present study were complemented by an oral health-related quality of life (OHRQoL) instrument that could be used as a predictor of oral problems that might lead to malnutrition in the elderly.

OHRQoL has been studied over the past 15 years, with the development and testing of measures designed to assess the functional, social, and psychosocial outcomes of oral disorders using self-reporting questionnaires (11). The Geriatric Oral Health Assessment Index (GOHAI) has proven to be an excellent tool for detecting oral disorders (12). On the other hand, the relative responsiveness of this measure to detect clinically meaningful change is not entirely clear (13). The GOHAI is a 12-item self-reported index, validated first in the United States in an elderly Caucasian sample (12), and subsequently in Hispanic, African-American (14), Chinese (15), French (16), and Spanish (17) samples. The 12 items assess three dimensions: physical functions (eating, speaking, and swallowing), psychosocial functions (worry or concern about oral health, dissatisfaction with appearance, self-consciousness about oral health, avoidance of social contacts because of oral problems), and pain or discomfort (use of medication to relieve pain, oral discomfort). The GOHAI pays special attention to problems related to food ingestion, which are addressed by one item in all four dimensions of the index: "trouble biting or chewing food" (functional limitation), "discomfort when eating" (pain and discomfort), "uncomfortable eating in front of people" (psychological impacts), and "limit kinds or amounts of food" (behavioral impacts) (15).

The Mini Nutritional Assessment (MNA), a clinical assessment tool for grading nutritional status and evaluating malnutrition risk in elderly patients that does not require a dietician or nutritionist for its application, has been used. MNA is a well-validated technique with high sensitivity, specificity, and reliability. It has been cross validated in a multicenter study and is based on anthropometric measurements, a global assessment of general health status, a dietary questionnaire, and a subjective assessment

Send correspondence and reprint requests to Dr José Antonio Gil-Montoya, Facultad de Odontología, Paseo de Cartuja s/n, 18071 Granada, Spain. Tel/Fax: +34-958243796; e-mail: jagil@ugr.es. J. A. Gil-Montoya and M. A. González-Moles are with the University of Granada School of Dentistry. C. Subirá and J. M. Ramón are with the University of Barcelona School of Dentistry. **Source of funding:** This study was funded by a grant from the Spanish Ministry of Health (FIS 99/1.119). Manuscript received: 12/4/06; accepted for publication: 10/27/07.

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of health and nutrition. It can also provide very useful information for the management of patients by indicating the factors that contribute to their altered nutritional status. Improvements in MNA scores have been observed after resulting interventions (18).

Detailed analysis of data on the four dimensions of the GOHAI and their association with the MNA results (19) improves our understanding of the complex relationship between oral health and malnutrition. The objective of this study was to investigate whether OHRQoL is associated with malnutrition risk in the elderly.

Methods

Study Design and Population Study. This cross-sectional study, part of the latest Spanish National Oral Health Survey of elderly people (20), was performed between July and December 1999. Study participants were over 64 years of age; 90 percent were randomly selected from among noninstitutionalized patients at primary care centers. Ten percent were randomly selected from among residents of geriatric care homes. Individuals with a presence of severe neurodegenerative disease were excluded.

Data Collection. Oral examinations and interviews were carried out by 16 previously calibrated dentists, with a mean Kappa index of 0.8 for caries detection. Data were gathered on sociodemographics, GOHAI, and MNA. Data were also collected on oral health status (according to the World Health Organization protocol) (21), e.g., edentulism, number of teeth present, presence of caries, number of filled and absent teeth, need for extraction, and finally, salivary disorders (presence of dry mouth, difficulty in swallowing food, and need to drink liquids to be able to swallow food).

For the GOHAI, participants were asked if they had always, often, sometimes, seldom, or never experienced problems related to physical functions, psychosocial functions, and pain or discomfort in the previous 3 months. Responses were scored on a scale ranging from 1 to 5. Because the scale score is the sum of these values, a low value indicates an oral health problem. An overall GOHAI score ranging from 12 to 60 was calculated for each person, with a higher score indicating better oral health. Individuals with a GOHAI score of 12 to 57 were identified as "needing dental care," and those with a score of more than 57 were identified as "not needing dental care" (12,17).

The MNA score (maximum score = 30 points) distinguishes between three categories of elderly patients: those with adequate nutrition (score $\geq$24), those at risk of malnutrition (score of 17 to 23.5), and those who are actually malnourished (score <17). Higher scores indicate a more satisfactory state of nutrition.

Associations between GOHAI and MNA and the capacity of GOHAI to predict malnutrition were explored. The significance of the difference between two or more means was assessed by using the Student's *t*-test or analysis of variance. The strength of association between two categorical variables was evaluated with the Pearson χ^2 test of independence. The significance level was set at $P < 0.05$. A multiple linear regression model was constructed, with the total MNA score (continuous variable) as the dependent variable. Variables entered in the model were age, gender, institutionalization (yes/no), dental status (dentate/edentulous), and GOHAI score (as continuous variable). Statistical analyses were performed by using SPSS Windows v.12.0 (SPSS Inc., Chicago, IL).

Results

The final sample included 2,860 elderly, 41.7 percent men and 58.3 percent women, with a mean age of 73.6 [standard deviation (SD) = 6.8] years; 88.5 percent of participants lived at home, 11.5 percent were institutionalized, and 30.1 percent were edentulous. Among the noninstitutionalized, 19.2 percent lived alone. The mean number of teeth was 10.5 (SD = 9.7) for the overall series and 14.7 (SD = 8.3) for the dentate group. The mean DMFT index value was 20.2 (SD = 10.5) for the overall series and 17.2 (SD = 8.8) for the dentate group. In the overall series, 24.1 percent had dry mouth while eating and 17.7 percent had to drink liquids with their food. Table 1 lists the demographic variables, percentage distribution of edentulous, the mean number of teeth, and the DMFT index in both dentate and edentulous older adults, showing differences as a function of age, institutionalization, and difficulty in swallowing.

The mean GOHAI score was 52.1 ± 7.2; 53.3 ± 6.4 for men and 51.2 ± 7.6 for women. The mean score was 52.1 ± 7.1 in noninstitutionalized versus 51.8 ± 7.7 in institutionalized participants, a nonsignificant difference. A maximum score of 60, indicating no impact from oral condition, was obtained by only 18.1 percent of the study population, and 2,022 (70.7 percent) were in need of dental care (GOHAI $\leq$57). Table 2 shows the differences between dentate and edentulous persons for the percentage who answered affirmatively (always, often, sometimes, or seldom) for each GOHAI item. Compared with dentate older adults, edentulous adults experienced more problems chewing, swallowing, and eating in front of other people, and they more frequently restricted the amount and type of their food intake. Likewise, results in Table 2 show that dentate participants more frequently used medication to relieve pain, experienced more discomfort with teeth and gums, and were less happy with their appearance and more worried about their teeth in comparison with edentulous participants. Nevertheless, no significant differences in total GOHAI score were found between the dentate (52.04) and edentulous groups (52.28).

Table 3 shows the distribution of MNA scores in relation to age, gender, institutionalization, and dentate status. The mean MNA score of the study sample was 24.0 ± 3.31; 3.5 percent were malnourished, 31.5 percent were at risk of malnutrition, and 65.0 percent were adequately nourished. Older age, being female,

Table 1
Description of the Sample and Their Oral Health Status

Variables	Whole sample ($n = 2,860$) n (%)	Dentate ($n = 2,000$) n (%)	Edentulous ($n = 860$) n (%)	P-value‡
Gender				0.11
Male	1,192 (41.7)	853 (42.7)	339 (39.4)	
Female	1,668 (58.39)	1,147 (57.4)	521 (60.6)	
Age (years)	73.6 ± 6.85*	72.6 ± 6.39*	76.0 ± 7.30*	<0.05
65-70	1,111 (38.8)	221 (25.7)	890 (44.5)	
71-75	703 (24.6)	206 (24.0)	497 (24.9)	
76-80	548 (19.2)	197 (22.9)	351 (17.6)	
>80	498 (17.4)	236 (27.4)	262 (13.1)	
Institutionalization				<0.05
Noninstitutionalized	2,530 (88.5)	1,808 (90.4)	722 (84.0)	
Institutionalized	330 (11.5)	192 (9.6)	138 (16.0)	
Dental status†				
Teeth present	10.5 ± 9.72*	14.7 ± 8.37*	–	
Caries		1.4 ± 2.66*	–	
Filled teeth		0.2 ± 0.53*	–	
Need for extraction		2.9 ± 2.90*	–	
Salivary problems				
Dry mouth when eating	691 (24.2)	468 (23.4)	223 (25.9)	0.16
Difficulty in swallowing	349 (12.2)	220 (11.0)	129 (15.0)	<0.05
Need to drink while eating	506 (17.7)	342 (17.1)	164 (19.1)	0.22

* Mean ± standard deviation.
† Per person.
‡ Comparison, dentate versus edentulous.

Table 2
Percentage of Dentate and Edentulous Elderly Who Responded Always, Often, Sometimes, or Seldom (i.e., Not "Never") to Each One of the Geriatric Oral Health Assessment Index Items

	Total ($n = 2,860$) n (%)	Dentate ($n = 2,000$) n (%)	Edentulous ($n = 860$) n (%)	Comparison P-value
Functional limitation				
Difficulties biting/chewing food (Q 2)*	1,446 (50.6)†	956 (47.8)	490 (57.0)	<0.001
Uncomfortable to swallow (Q 3)	790 (27.6)	502 (25.1)	288 (33.5)	<0.001
Prevented from speaking (Q 4)	762 (26.6)	487 (24.4)	275 (32.0)	<0.001
Pain and discomfort				
Discomfort when eating (Q 5)	1,237 (43.3)	847 (42.4)	390 (45.3)	n.s.
Use medication to relieve pain (Q 11)	1,351 (47.2)	980 (49.0)	371 (43.1)	<0.001
Teeth, gums sensitive to heat/cold (Q 12)	915 (32.0)	789 (39.5)	126 (14.7)	<0.001
Psychological impacts				
Unhappy with appearance (Q 7)	1,179 (41.2)	856 (42.8)	323 (37.6)	<0.01
Worried or concerned (Q 8)	1,399 (48.9)	1,021 (51.1)	378 (44.0)	<0.001
Nervous or self-conscious (Q 9)	1,072 (37.5)	748 (37.4)	324 (37.7)	n.s.
Uncomfortable eating in front of people (Q 10)	934 (32.7)	614 (30.7)	320 (37.2)	<0.001
Behavioral impacts				
Limit on kinds or amounts of food (Q 1)	1,170 (40.9)	794 (39.7)	376 (43.7)	<0.05
Limit on contacts with others (Q 6)	660 (23.1)	433 (21.7)	227 (26.4)	<0.001

* Question number.
† Each individual could respond affirmatively to more than one item.
n.s., nonsignificant.

institutionalization, and edentulism were associated with malnutrition risk ($P < 0.01$).

A strong association was found between mean GOHAI (total GOHAI) and MNA scores, considered both as continuous and categorical variables (Table 4). When this association was adjusted for age, gender, dentate status, and institutionalization, the association remained statistically significant, with the exception of dentate status (Table 5). The GOHAI score was higher (better perception of oral health) among those at least risk of

Table 3
Distribution of MNA Results

	Risk of malnutrition (%)			Mean MNA score Mean ± standard deviation
	Malnourished	Risk of malnutrition	Adequate	
Age (years)				
65-70	1.6	27.5	70.9	24.5 ± 2.96
71-75	2.3	29.7	68.0	24.2 ± 3.02
76-80	4.6	35.2	60.2	23.6 ± 3.25
>80	7.9	39.0	53.1	22.8 ± 4.12
Association		$P < 0.001$*		$P < 0.001$†
Sex				
Male	2.0	26.6	71.4	24.5 ± 3.07
Female	4.5	35.1	60.4	23.6 ± 3.42
Association		$P < 0.001$*		$P < 0.001$†
Institutionalization				
Noninstitutionalized	3.1	30.1	66.8	24.1 ± 3.17
Institutionalized	6.1	42.7	51.2	22.8 ± 4.03
Association		$P < 0.001$*		$P < 0.001$†
Dentate	3.0	30.5	61.3	24.2 ± 3.20
Edentulous	4.7	34.1	66.6	23.7 ± 3.42
Association		$P < 0.01$*		$P < 0.001$†

* Chi-square test.
† Analysis of variance, *t*-test.
MNA, Mini Nutritional Assessment.

Table 4
Association of MNA with Recoded GOHAI

	Total MNA Mean ± standard deviation	Malnourished *n* (%)	Risk of malnutrition *n* (%)	Adequate *n* (%)
GOHAI	24.01 (3.3)			
Total GOHAI	$r = 0.245$, $P < 0.001$†			
GOHAI-mastication*	$r = 0.264$, $P < 0.001$†			
Need oral care (GOHAI ≤57)	23.7 ± 3.4	84 (84.8)	685 (75.9)	1,253 (67.4)
Do not need oral care (GOHAI >57)	24.6 ± 2.9	15 (15.2)	217 (24.1)	606 (32.6)
	$P < 0.001$‡		$P < 0.001$¶	

* Five items directly related to mastication have been recoded as a single variable: "GOHAI-mastication."
† Pearson's correlation coefficient.
‡ Analysis of variance test.
¶ Chi-square test.
GOHAI, Geriatric Oral Health Assessment Index; MNA, Mini Nutritional Assessment.

Table 5
Multiple Logistic Regression Analysis for the Association between GOHAI and MNA

Variable	β	95% confidence interval	*P*-value
Age	0.031	1.01-1.04	$P < 0.001$
Male	0.346	1.19-1.66	$P < 0.001$
Dentate	−0.110	0.75-1.06	0.224
Institutionalization	0.402	1.16-1.92	$P < 0.05$
GOHAI	−0.053	0.93-0.95	$P < 0.001$

Dependent variable: MNA.
GOHAI, Geriatric Oral Health Assessment Index; MNA, Mini Nutritional Assessment.

malnutrition. When the GOHAI was considered as a categorical variable (need/no need for oral care), it again showed a clear and significant association with MNA results.

This strong association ($P < 0.001$) persisted when the GOHAI-mastication score (recoded variable from the five items directly related to chewing) was compared with MNA, even after adjustment for age, gender, dentate status, and institutionalization, again with the exception of the dentate status variable.

In the multiple linear regression model with global MNA score as the dependent variable, the model only explained 6 percent of the variability of MNA ($r^2 = 0.07$) (Table 5).

Discussion

In this study of an elderly population, OHRQoL rating was associated with the risk of malnutrition after adjusting for age, sex, and institutionalization status, regardless of their dentate status. Thus, the elderly with a poor perception of their oral health state also had a lower MNA score. In fact, more than 80 percent of the individuals classified by MNA results as malnourished required dental care according to their GOHAI score. Despite the clear evidence in the literature of a relationship between oral health status and food intake (4-8,22-24), almost all studies to date used only objective clinical variables, e.g., number of teeth, tooth distribution, number of occluding natural pairs of teeth, tooth condition (7), or duration and number of chewing strokes before swallowing (4). Perception of oral health status does not always coincide with objective clinical data in the elderly, and it is also useful to assess oral health in terms of function. Therefore, OHRQoL tools for the elderly that take account of the functional, social, and psychological repercussions of their oral health are valuable. Only Daly et al. (25) have evaluated the OHRQoL as part of an analysis of oral health status and malnutrition risk. Their study, using the Oral Health Impact Profile and MNA in a small sample of elderly, found no association between these two variables.

Associations were also observed between GOHAI and the MNA-evaluated malnutrition risk. In the regression analysis, in which the possible confounding factors were controlled for, MNA results were significantly associated with GOHAI score, age, sex, and institutionalization, but not with dental status. Other authors describe the number of teeth as a variable associated with malnutrition (8), and the absence of this relationship probably results from the fact that only 8 percent of these elderly people who needed a complete prosthesis did not have one, suggesting that prosthetic rehabilitation may have played an important role in the prevention of malnutrition risk among the remaining older adults.

A high prevalence of the different mastication-related problems was detected (limits on types or amounts of food, difficulties with biting or chewing food, discomfort when swallowing or eating, and feeling uncomfortable eating in front of people), which is supportive of reports by other authors (4). Data previously published by our group showed that a large proportion of the studied sample were malnourished or at risk of malnutrition (26). However, not all of the malnutrition risk conditions observed would imply the presence of real malnutrition, despite the high sensitivity of MNA for detecting malnourishment (27). More biochemical and hematological data would be required to confirm this diagnosis. Few studies have investigated in depth the consequences of oral problem-induced limitations for the type or amount of food intake (7,28,29). Sheiham et al. (7) reported that a restriction in foods because of mastication difficulties only very occasionally produced a deficit in key nutrients (except vitamin C) detectable by biochemical analysis that could cause a clinical nutritional disease. Hence, these results should always be interpreted in terms of malnutrition risk rather than actual malnutrition.

Besides the large number of reported mastication-related problems in this elderly population, the present results show the strong association of an OHRQoL measure with malnutrition in individuals with oral health concerns, although the actual diagnosis of malnutrition requires a more complex study of the patient. This finding is of interest because application of the MNA requires special training and specific instruments. However, the relative responsiveness of GOHAI to changes in the malnutrition status of a population remains unclear, and longitudinal studies are required to address this issue.

Despite including a large and representative sample of Spanish elderly, this study cannot yield conclusive data on causality because of its cross-sectional design. Moreover, the study series had a low proportion of individuals with malnutrition a priori, which was a study limitation for identifying risk prediction factors such as the OHRQoL. Otherwise, the apparently limited value of the multivariate analysis, explaining only 6 percent of the variability of MNA, suggests the complex nature of these conditions. Many other factors, unstudied in this research, contribute to the relationship between OHRQoL and malnutrition.

In conclusion, OHRQoL assessment is associated with MNA-estimated malnutrition risk. These tools, designed to detect the outcomes of oral–facial disorders in general, may also serve to identify individuals at risk of malnutrition caused by oral problems. A combination of poor oral health status and unfavorable results for chewing-related OHRQoL items should alert dental professionals to the possibility of nutritional problems, especially in a population as vulnerable as the elderly.

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References

1. Chandra R, Imbach A, Moore C, Skelton D, Woolcott D. Nutrition of the elderly. CMAJ. 1991;145:1475-87.
2. Wilson MM, Vaswani S, Liu D, Morley JE, Miller DK. Prevalence and causes of undernutrition in medical outpatients. Am J Med. 1998;104:56-63.
3. Dirren HM. EURONUT-SENECA: a European study of nutrition and health of the elderly. Nutr Rev. 1994;52:38-43.
4. Lamy M, Mojon Ph, Kalykakis G, Legrand R, Butz-Jorgensen E. Oral status and

nutrition in the institutionalized elderly. J Dent. 1999;27:443-8.
5. Halling A, Bengtsson C. Diet in relation to number of remaining teeth in a population of middle-aged women in Gothenburg, Sweden. Swed Dent J. 1989;12:39-45.
6. Sheiham A, Steele J. Does the condition of the mouth and teeth affect the ability to eat certain foods? Nutrient and dietary intake and nutritional status amongst older people. Public Health Nutr. 2001;4:797-803.
7. Sheiham A, Steele JG, Marcenes W, Lowe C, Finch S, Bates CJ, Prentice A, Walls AW. The relationship among dental status, nutrient intake, and nutritional status in older people. J Dent Res. 2001;80:408-13.
8. Appollonio I, Carabellese C, Frattola A, Trabucchi M. Influence of dental status on dietary intake and survival in community-dwelling elderly subjects. Age Ageing. 1997;26:445-55.
9. Andersson K, Gustafsson A, Buhlin K. Self-perceived oral function in elderly residents in a suburban area of Stockholm, Sweden. Oral Health Prev Dent. 2004;2:195-201.
10. Locker D, Gibson B. Discrepancies between self-ratings of and satisfaction with oral health in two older adult populations. Community Dent Oral Epidemiol. 2005;33:280-8.
11. Slade GD, editor. Measuring oral health and quality of life. Chapel Hill: University of North Carolina, Dental Ecology; 1997.
12. Atchinson K, Dolan T. Development of the Geriatric Oral Health Assessment Index. J Dent Educ. 1990;54:680-7.
13. Locker D, Matear D, Stephens M, Lawrence H, Payne B. Comparison of the GOHAI and OHIP-14 as measures of the oral health-related quality of life of the elderly. Community Dent Oral Epidemiol. 2001;29:373-81.
14. Atchinson KA, Der-Martirosian C, Gift H. Components of self-reported oral health and general health in racial and ethnic groups. J Public Health Dent. 1998; 58:301-7.
15. Wong MC, Liu JK, Lo EC. Translation and validation of the Chinese version of the GOHAI. J Public Health Dent. 2002; 62:78-83.
16. Tubert-Jeannin S, Riordan PJ, Morel-Papernot A, Porcheray S, Saby-Collet S. Validation of an oral health quality of life index (GOHAI) in France. Community Dent Oral Epidemiol. 2003;31:275-84.
17. Pinzón S, Gil-Montoya JA. Validación del Índice de Valoración de Salud Oral en Geriatría en una población geriátrica institucionalizada de. Granada. Rev Esp Geriatr Gerontol. 1999;34:273-82.
18. Guigoz Y. The Mini Nutritional Assessment (MNA®). Review of the literature – what does it tell us? J Nutr Health Aging. 2006;10:466-85.
19. Soini H, Muurinen S, Routasalo P, Sandelin E, Savikko N, Suominen M, Ainamo A, Pitkala KH. Oral and nutritional status – is the MNA® a useful tool for dental clinics? J Nutr Health Aging. 2006;10:495-501.
20. The Spanish Geriatric Oral Health Research Group. Oral health issues of Spanish adults aged 65 and over. Int Dent J. 2001;51:7-10.
21. World Health Organization. Oral health surveys. Basic methods. 4th ed. Geneva: WHO; 1997.
22. Steele JG, Sheiham A, Marcenes W, Walls AWG. National Diet and Nutrition Survey: people aged 65 years and over, vol. 2. Report of the Oral Health Survey. London: The Stationery Office; 1998.
23. Soini H, Routasal P, Lauri S, Ainamo A. Oral and nutritional status in frail elderly. Spec Care Dentist. 2003;23:209-15.
24. De Oliveira T, Frigerio M. Association between nutrition and the prosthetic condition in edentulous elderly. Gerodontology. 2004;21:205-8.
25. Daly RM, Elsner RJF, Allen PF, Burke FM. Associations between self-reported dental status and diet. J Oral Rehabil. 2003;30:964-70.
26. Ramon JM, Subirá C. Grupo de Investigación en Gerodontología. Prevalencia de Malnutrición en la Población Anciana Española. Med Clin. 2001;117:766-70.
27. Jensen GS, Kita K, Fish J, Heydt D, Frey C. Nutrition risk screening characteristics of rural older persons: relations to functional limitations and health changes. Am J Clin Nutr. 1997;66:819-28.
28. Moyniham PJ, Snow S, Jepson NJ, Butler TJ. Intake of non-starch polysaccharide (dietary fibre) in edentulous and dentate persons: an observational study. Br Dent J. 1994;177:243-7.
29. Joshipura KJ, Willet WE, Douglass CW. The impact of edentulousness on food and nutrient intake. J Am Dent Assoc. 1996;127:459-67.