EDENTULISM AND DENTAL PROSTHESES IN THE ELDERLY: IMPACT ON QUALITY OF LIFE MEASURED WITH EUROQOL – VISUAL ANALOG SCALE (EQ-VAS)

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ABSTRACT

The objective of this study was to measure the impact of edentulism and dental prostheses on quality of life (QOL) in older adults in Bogotá, Colombia. Edentulism is a frequent condition in older adults and has great impact on their QOL. No epidemiological data are currently available on edentulism among older adults in Colombia. Data were obtained from the SABE-Bogotá study, a cross-sectional study conducted in 2012, and used to analyze the EQ-VAS (Visual Analog Scale) from the EuroQol instrument to measure the perception of quality of life (QOL) in relation to edentulism. The study included 2,000 individuals over 60 years old. The Spearman-Rho correlation was used to analyze the correlation between EQ-VAS and edentulism. Chi-Square, ANOVA and t-test were used to study the differences in EQ-VAS scores between edentulous and healthy subjects. Statistical significance was set at $p<0.05$. Of the 2000 respondents, 98.3% were edentulous, 73.0% reported half or more missing teeth, 76.9% used dental prostheses and 23.7% had related eating problems. Older age, lower social class and lower education were related to edentulism. Individuals with fewer teeth and dental prostheses had lower EQ-VAS scores ($p<0.05$) and dental prosthesis did not improve EQ-VAS scores ($p=0.22$). Edentulism also showed a significant negative correlation with EQ-VAS scores (rho= -0.102, $p<0.01$). In summary, EQ-VAS is a useful tool for measuring the perception of QOL in dental health scenarios. Edentulism significantly affects QOL in older adults and the use of dental prosthesis does not improve the perception of QOL.

Key words: *Mouth, Edentulous, Quality of life, Aging, Dental prosthesis.*

EDENTULISMO Y PRÓTESIS DENTALES EN EL ADULTO MAYOR: IMPACTO SOBRE LA CALIDAD DE VIDA MEDIDO CON EUROQOL – ESCALA VISUAL ANÁLOGA (EQ-VAS)

RESUMEN

El objetivo de este estudio fue medir el impacto del edentulismo y el uso de prótesis dentales en la calidad de vida de los adultos mayores en Bogotá, Colombia. El edentulismo es frecuente en los adultos mayores y afecta profundamente su calidad de vida. Actualmente existen pocos datos epidemiológicos disponibles sobre este tema en nuestro medio. Los datos fueron extraídos del estudio SABE-Bogotá, estudio transversal por conglomerados llevado a cabo en el 2012. Se uso el EQ-VAS (escala visual análoga) como instrumento de medición de la percepción de la calidad de vida. El estudio incluyó 2.000 individuos mayores de 60 años. Se usó el test de Sperman-Rho para analizar la correlación entre el EQ-VAS, el edentulismo y el uso de prótesis. Las pruebas de Chi-cuadrado, ANOVA y t-test se usaron para estudiar las diferencias en los puntajes del EQ-VAS entre los sujetos edéntulos y sanos. La significancia estadística se estableció en <0.05. De los 2000 encuestados, 98.3% fueron edéntulos, 73.0% reportaron perdida de mas de la mitad de sus dientes, 76.9% reportaron usar prótesis dentales y 23.7% problemas relacionados con la alimentación. La edad avanzada, el estrato social bajo y el bajo nivel educativo se relacionaron con mayor pérdida dental. Individuos con pocos dientes y prótesis dentales tuvieron puntajes bajos en el EQ-VAS ($p=0.22$). La presencia de edentulismo también mostró una correlación negativa con los puntajes del EQ-VAS (rho= -0.102, $p<0.01$). Se concluye que EQ-VAS es un instrumento de gran utilidad para la medición de calidad de vida en contextos relacionados a salud oral. El edentulismo afecta significativamente la calidad de vida en los adultos mayores y el uso de prótesis dentales no mejora la percepción de la calidad de vida.

Palabras clave: *Boca, Edentulismo, Calidad de vida, Envejecimiento, Prótesis dentales.*

INTRODUCTION

The elderly population has increased rapidly worldwide in recent decades due to the demographic transition[1] which is accompanied by an increase in longevity and age-dependent chronic diseases[2]. Oral diseases are among the most prevalent conditions in the elderly[3,4] and affect quality of life (QOL) as a result of infections, functional impairment, poor self-esteem, socialization issues, communication and chewing problems[5,6]. Edentulism therefore represents a difficult challenge for public health given that poor oral health leads to a broad spectrum of comorbidities, such as malnutrition, frailty, and deterioration of preexistent chronic diseases, and decreases overall health status[7,8]. Most importantly, these conditions increase morbidity and mortality rates [9].

The most frequent causes of poor dental health are caries, periodontal disease and edentulism; the latter being a consequence and a common outcome of caries and periodontal disease[10]. Edentulism is the loss of at least one tooth (partial edentulism) or the loss of all the teeth (total edentulism)[4]. In the elderly, high prevalence rates have been reported for caries (47 to 91.9%), periodontal disease (36 to 89%) and edentulism (20 to 65%)[3,6,11-18].

In clinical practice, oral and dental examinations are the basis for identifying early oral diseases, signs of malnourishment and systemic diseases and infections that could be the result or the cause of dental health issues. Recently developed technology has enabled successful treatment of these diseases. Nevertheless, there are still serious problems involving dental health in the elderly, due to the following reasons: access to oral health services is limited, services are expensive and frequently not covered by insurance companies[19], poor hygiene habits and the lack of dental health information provided to older adults[20,21].

Dental prosthesis usage has been shown to increase QOL by improving dental function. However, it has been reported that people are often not aware of the proper use of the prosthesis or simply do not use it despite their need[19,22]. Furthermore, a complete nutritional assessment is a priority in edentulous individuals and dental prosthesis users because they typically eat food with low nutritional value to facilitate chewing. Adequate nutritional status in edentulous patients is maintained by proper usage of the prosthesis and health care of the gingiva and remaining teeth.

Several approaches have been used to measure QOL[23]. One of the most widely used instruments for measuring QOL is the EuroQOL questionnaire[24], developed by "The International European Quality of Life Group" to be applied internationally and standardized to measure QOL in the context of different diseases[25,26]. {Leeds, 2004 #850} It has also been used and validated for Latin American countries in standard Spanish. This study used the Spanish version to analyze the relationship between QOL and dental health in the elderly [27,28].

This study evaluates the impact of edentulism and the usage of dental prostheses on the self-perceived QOL of older adults in the city of Bogotá, Colombia

MATERIAL AND METHODS

The SABE Bogotá study (Health, Wellbeing and Aging) is a probabilistic cross-sectional study. Data were collected from a sample selected by clusters in a multistage process (Sectors, sub-sections of neighborhoods, blocks, and sets of 10 houses); a correction factor was used for a statistical confidence of 95%. The total response rate was 81.9%. The sample of 2000 older adults aged 60 years and older was statistically representative of this population.

The Pan American Health Organization designed the SABE survey for Latin American countries including 11 main topics[29]: 1) identification of the house and the elderly older adults to be interviewed; 2) house and home characteristics; 3) personal and family data; 4) experiences of violence; 5) cognitive status; 6) health status; 7) characterization and causes of disabilities; 8) functional evaluation; 9) medication usage and access to health services; 10) anthropometrics and physical performance tests; 11) health, disease and a social history framework (biological component).

Data were collected by fieldwork teams including: 1 supervisor, 3 to 4 interviewers and 1 anthropometrics specialist. The teams were trained by the principal investigator, field researchers, a statistician and a field coordinator. The collected data were digitalized and saved in Microsoft Excel, software version 2011. All respondents signed an informed consent in order to participate in the study, which was approved by ethics committee of the Pontificia Universidad Javeriana.

Variables

Dependent Variables

To characterize edentulism, we used related questions: 1. How many missing teeth do you have? (None, 1 to 4, 4 to half, more than half, all the teeth); 2. Do you use dental prosthesis? (Yes/no); 3. During the last 12 months, have you experienced any difficulties in eating related to issues with your teeth or dental prosthesis? (Yes/no).

To measure QOL we used the EuroQol instrument, which has two main components: 1. EQ-5D, which evaluates 5 dimensions (Mobility, self-care, usual activities, pain/discomfort and anxiety/depression) and 2. EQ-VAS (Visual Analog Scale) which is a scale of 0 to 100 that allows individuals to place themselves according to how they perceive their overall health status (0 is the worst and 100 the best health status). For the purposes of this study we used the EQ-VAS as a tool for measuring health-related QOL in edentulous older adults.

Independent Variables

Socio-demographic variables: Age (age groups); Sex (male or female); Social class [Social class in Colombia is divided into strata (1-6, with 1 being the lowest and 6 the highest). We created three categories using the 6 classes 1-2 (Lower), 3-4 (middle) and 5-6(upper).[30]]; and Educational level [evaluated as years of education (0, 1-5, ≥6)]. The questions related to edentulism were also used as independent variables when we evaluated EQ-VAS scores.

Statistical Analysis

We performed a descriptive analysis of edentulism and the socio-demographic variables with Chi-Square test to find differences between groups. Then we used the EQ-VAS as a continuous dependent variable to evaluate perceived QOL. This variable followed a normal distribution and we performed parametric analyses. Results are presented as mean scores ± SEM (standard error of the mean); One Way-ANOVA or t-test was used to find statistically significant differences between edentulous and healthy subjects. When appropriate, a post-hoc test (LSD-Fisher) was used to determine significant differences between groups. Statistical correlations were estimated with Spearman-Rho correlation test given that the distribution for edentulism categorical variables was not normal. Statistical significance was accepted for p-values less than 0.05. Data analysis was performed using the software IBM SPSS Statistics version 21 for Mac and for figure preparation Sigma Plot by SYSTAT Software Inc. version 12 for Windows.

RESULTS

General Demographics and Prevalence of Edentulism

Of the 2000 respondents, 62.4% were female and 37.6% were male. Age (in years) groups had similar frequencies: 60-64 with 25.3%, 65-69 with 22.7%, 70-74 with 19.9%, and ≥75 had the highest frequency (32.1%). For socioeconomic status, the highest proportion was in the lower social class (51.9%), followed by middle social class (44.9%) and upper social class (3.3%). A total 98.3% were edentulous, 73.0% had lost more than half their teeth and 1.7% had complete natural teeth. 77.0% used dental prosthesis, 23.0% were edentulous and did not use dental prosthesis. Individuals with eating problems related to teeth or dental prosthesis were 23.7% (Table 1).

Table 2 shows the prevalence of edentulism by categories. Individuals who have lost more than half their teeth showed higher prevalence among women (76.6%), older age (82.5% over 75 years), lower

Table 1: Socio-demographic data Demographics about of the elderly population in the SABE Bogotá-study.

Category	n (%)
Sex	
Male	751 (37.6)
Female	1249 (62.5)
Age (years)	
60-64	506 (25.3)
65-69	454 (22.7)
70-74	398 (19.9)
≥75	642 (32.1)
Social Class	
Lower class	1038 (51,.9)
Mild Middle class	897 (44,.9)
Upper class	65 (3,.3)
Educational level (years)	
0	244 (12,.2)
1-6	1111 (55,.6)
≥6	645 (32,.3)
Edentulism (number of missing teeth)	
All teeth present	34 (1.7)
Less than four missing	276 (14)
Four to half missing	222 (11.3)
More than half missing	1441 (73.0)
Edentulism related conditions	
Dental prosthesis	1535 (77.0)
Edentulous with no prosthesis	459 (23.0)
Eating problems related to issues with natural teeth or prosthesis	474 (23.7)

Table 2: Missing teeth by sex, age groups, social classes and educational level.

	All teeth present n (%)	Less than half missing n (%)	More than half missingn (%)	Total n (100%)	p value[a]
Sex					
Male	13 (1,.7%)	231 (31,.0%)	500 (67,.2%)	744	*
Female	21 (1,.7%)	267 (21,.7%)	941 (76,.6%)	1229	*
Age (years)					
60-64	12 (2,.4%)	188 (37,.5%)	301 (60,.1%)	501	*
65-69	9 (2,.0%)	112 (24,.9%)	329 (73,.1%)	450	*
70-74	6 (1,.5%)	95 (24,.2%)	292 (74,.3%)	393	*
≥75	7 (1,.1%)	103 (16,.4%)	519 (82,.5%)	629	*
Social class					
Lower class	8 (0,.8%)	206 (20,.3%)	801 (78,.9%)	1015	*
Mild Middle class	22 (2,.5%)	258 (28,.9%)	613 (68,.6%)	893	*
Upper class	4 (6,.2%)	34 (52,.3%)	27 (41,.5%)	65	*
Education level (years)					
0	2 (0,.8%)	35 (14,.7%)	201 (84,.5%)	238	*
1-6	17 (1,.6%)	231 (21,.2%)	843 (77,.3%)	1091	*
≥6	15 (2,.3%)	232 (36,.0%)	397 (61,.6%)	644	*

[a] Chi-square test * p<0.001.

social-class (78.9%) and lower educational level (84.5%). The frequency of complete teeth decreased from younger to older age groups (2.4% for 60-64 ys., 2.0% for 65-69 ys., 1.5% for. 70-74 ys. and 1.1% for individuals ≥ 75 ys), from higher to lower social class (6.2% for upper class, 2.5% for middle class and 0.8% for lower class) and from higher to lower educational level (2.3% for more than 6 years education, 1.6% for 1-5 years education and 0.8% for 0 years education). Statistically significant values were obtained for all categories.

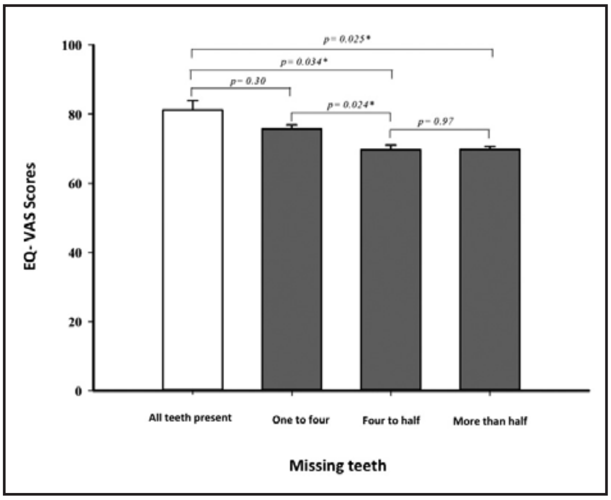

*Fig. 1: Quality of life (EQ-VAS) scores for groups with missing teeth and healthy subjects. One-way ANOVA, (LSD-Fisher). *p< 0.05. (n= 2000).*

Quality Of Life in Edentulous Older Adults Measured with EQ-VAS

Fig. 1 shows the differences in EQ-VAS scores between edentulous groups and subjects with complete teeth. EQ -VAS scores for those with complete teeth were 81.2 ±2.7 and significantly lower in edentulous groups. EQ-VAS scores decreased as the number of missing teeth increased with a significant negative correlation for edentulism and EQ-VAS, (rho= -0.102, p<0.01). (Data not shown).

EQ-VAS scores for edentulous groups that used dental prosthesis (70.1±0.5) did not differ significantly (p= 0.22) from those that did not use dental prosthesis (72.9±2.2). However, the presence of eating problems related to issues with the teeth or dental prosthesis was significantly lower 65.3±1.0 than no eating problems 72.2±0.5 (p<0.05, Table 3).

DISCUSSION

Dental health progressively deteriorates in the elderly, leading to a complex scenario for overall health in this population. The most frequent dental health problems include caries, periodontal disease, pathological tooth migration, loss of alveolar supportive tissue and finally, partial and total edentulism[31-33]. The aging process may contribute to these problems, but does not cause them[21,34]. The main etiologies are lack of hygiene and appropriate dental health habits, as has been widely discussed and reported in the literature.[20,33,35] Previous studies of the Colombian population (ENSAB III) reported data on individuals up to 69 years of age and did not characterize edentulism.[36] This is the first study that provides epidemiological data for edentulism and its impact on QOL in the elderly in the city of Bogotá, Colombia.

We found that the prevalence of edentulous individuals is close to 100% and most of them have lost more than half their teeth, representing a relevant public health problem. This prevalence is highest in women, those in lower social class, individuals with lower educational level and those over 75 years of age. Edentulism also showed a deleterious impact on QOL, as shown by significantly lower scores in EQ-VAS in edentulous individuals. As expected, the highest scores corresponded to older adults with complete teeth, and although their perceived QOL was higher, it did not differ significantly from those with up to four missing teeth. However, QOL was considerably affected in individuals with a greater number of missing teeth, who reported significantly lower scores in the edentulous groups that have lost less than half or more than half of their teeth, suggesting that the loss of more than four teeth affects the perception of QOL as much as the loss of more than half of the natural teeth.

On the other hand, an important measure for improving health and QOL in edentulous people is the use of dental prostheses, although users must know how to use and handle them[19]. We found that 23.1% of individuals with edentulism did not use prostheses and those who did use them did not report an improvement in their perceived QOL. This is not surprising, given that dental prosthesis implementation requires a complete oral rehabilitation process, including continuous follow-up, patient education, special care and adaptation or change of the device if necessary, all of which are limited in this population. Furthermore, the presence of eating problems related to issues with the natural teeth or prosthesis has a significant detrimental effect on QOL compared to the absence of eating problems.

Table 3: Visual analogue scale by for eating problems related to issues with natural teeth or prosthesis.

Problems	EQ-VAS Mean ±SEM	p value[a]
Yes	65,.3 ±1	*
No	72,.2 ± 0.5	

aT-test *p<0.0001, (n= 1534).

The fact that QOL does not improve in older adults with the use of dental prostheses suggests that they are missing out on important advantages and benefits. Further studies on this population are needed in order to better understand why these dental health measures do not have the intended impact. It is a priority to increase the coverage of dental health care in older adults and improve their understanding on how to use these devices properly, through prevention and education campaigns focused on the oral health of the elderly.[37] Despite the complexity of measuring QOL, the EuroQol (EQ-VAS) instrument provides a very good tool which is easy to use at a very low cost and can be implemented routinely in these dental health studies.

This study has some limitations. It was a cross-sectional study and it was not possible to evaluate the precise sequence of events and factors leading to edentulism. It was not possible to determine either the causes of or factors related to missing the benefits of dental prosthesis. Despite these limitations there are also several strengths. It is the first study to examine dental health, the prevalence of edentulism and prostheses and their impact on QOL of the elderly in Colombia.

Finally, there is high prevalence of edentulous individuals among the older adults of Bogotá, many of whom do not use dental prostheses. Most of these individuals had lost more than half their teeth and we found a clear increased association with sex (females), older age groups, lower social-classes and lower educational levels. These vulnerable groups in the older adult population are at high risk of having poor dental health, which in turn is widely reported to be associated with a wide range of illnesses such as malnourishment, chronic diseases and disability[4,38]. These findings highlight the importance of creating public policies to improve dental health in populations that are less able to afford dental healthcare or do not have enough knowledge about dental hygiene and health, as is the case in lower social classes and lower educational levels. Studies are also needed to identify the reasons why women are more edentulous than men. Most importantly, such public policies should focus on a continuous educational oral rehabilitation process, especially in elderly people who require dental prostheses.

EQ-VAS is a useful tool for measuring the perception of QOL in dental health scenarios. Herein we report that edentulism significantly affects QOL in older adults and that strikingly, dental prosthesis usage did not improve the perception of QOL, possibly due to the lack of knowledge on their appropriate use. It is imperative to collect new epidemiological data about the current status of oral health in the elderly population.

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REFERENCES

1. Lee R. The Demographic Transition: Three Centuries of Fundamental Change. Journal of Economic Perspectives 2003;17:167-190.
2. Samper-Ternent R, Karmarkar A, Graham J, Reistetter T, Ottenbacher K. Frailty as a predictor of falls in older Mexican Americans. Journal of Aging and Health 2012; 244:641-653.
3. Muller F, Naharro M, Carlsson GE. What are the prevalence and incidence of tooth loss in the adult and elderly population in Europe? Clinical oral implants research 2007;18 Suppl 3:2-14.
4. Felton DA. Edentulism and comorbid factors. Journal of prosthodontics: official journal of the American College of Prosthodontists 2009;18:88-96.
5. Griffin SO, Barker LK, Griffin PM, Cleveland JL, Kohn W. Oral health needs among adults in the United States with chronic diseases. Journal of the American Dental Association 2009;140:1266-1274.
6. Medina-Solis CE, Perez-Nunez R, Maupome G, Casanova-Rosado JF. Edentulism among Mexican adults aged 35 years and older and associated factors. American journal of public health 2006;96:1578-1581.
7. Sheiham A, Steele JG, Marcenes W, Tsakos G, Finch S, Walls AW. Prevalence of impacts of dental and oral disorders and their effects on eating among older people; a national survey in Great Britain. Community dentistry and oral epidemiology 2001;29:195-203.
8. Hebling E, Pereira AC. Oral health-related quality of life: a critical appraisal of assessment tools used in elderly people. Gerodontology 2007;24:151-161.
9. Cano C, Samper-Ternent R, Al SS, Markides K, Ottenbacher KJ. Frailty and cognitive impairment as predictors of mortality in older Mexican Americans. J.Nutr.Health Aging 2012;16:142-147.
10. Dolan TA, Gilbert GH, Duncan RP, Foerster U. Risk indicators of edentulism, partial tooth loss and prosthetic status among black and white middle-aged and older adults. Community dentistry and oral epidemiology 2001;29: 329-340.
11. Mojon P, Thomason JM, Walls AW. The impact of falling rates of edentulism. The International journal of prosthodontics 2004;17:434-440.
12. Bergman JD, Wright FA, Hammond RH. The oral health of the elderly in Melbourne. Australian dental journal 1991; 36:280-285.
13. Islas-Granillo H, Borges-Yanez SA, Lucas-Rincon SE, et al. Edentulism risk indicators among Mexican elders 60-year-old and older. Archives of gerontology and geriatrics 2011;53:258-262.
14. Locker D, Slade G. Oral health and the quality of life among older adults: the oral health impact profile. Journal 1993;59: 830-833, 837-838, 844.
15. Marcus SE, Drury TF, Brown LJ, Zion GR. Tooth retention and tooth loss in the permanent dentition of adults: United States, 1988-1991. Journal of dental research 1996;75 Spec No:684-695.
16. Rodrigues SM, Oliveira AC, Vargas AM, Moreira AN, EF EF. Implications of edentulism on quality of life among elderly. International journal of environmental research and public health 2012;91:100-109.
17. Salonen L. Oral health status in an adult Swedish population. A cross-sectional epidemiological study of the northern Alvsborg county. Swedish dental journal. Supplement 1990;70:1-49.
18. Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century—the approach of the WHO Global Oral Health Programme. Community dentistry and oral epidemiology 2003;31 Suppl 1:3-23.

19. WHO. More oral health care needed for ageing populations. Vol 83. Bulletin of the World Health Organization: WHO; 2005.
20. Srivastava R, Gupta SK, Mathur VP, Goswami A, Nongkynrih B. Prevalence of dental caries and periodontal diseases, and their association with socio-demographic risk factors among older persons in Delhi, India: a community-based study. The Southeast Asian journal of tropical medicine and public health 2013;44:523-533.
21. Davidovich E, Kooby E, Shapira J, Ram D. Oral hygiene habits, dental home, and toothbrushing among immigrant and native low socioeconomic class populations. The Journal of clinical pediatric dentistry 2013;37:341-344.
22. De Marchi RJ, Hugo FN, Hilgert JB, Padilha DM. Association between oral health status and nutritional status in south Brazilian independent-living older people. Nutrition 2008; 24:546-553.
23. Fitzpatrick R, Fletcher A, Gore S, Jones D, Spiegelhalter D, Cox D. Quality of life measures in health care. I: Applications and issues in assessment. BMJ 1992;305:1074-1077.
24. Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. Annals of medicine 2001;33: 337-343.
25. Leeds L, Meara J, Hobson P. The impact of discharge to a care home on longer term stroke outcomes. Clinical rehabilitation 2004;18:924-928.
26. Villar Balboa I, Carrillo Munoz R, Regi Bosque M, Marzo Castillejo M, Arcusa Villacampa N, Segundo Yague M. [Factors associated with the quality of life in patients with chronic obstructive pulmonary disease.]. Atencion primaria / Sociedad Espanola de Medicina de Familia y Comunitaria 2013;46:179-187.
27. Sanchez-Arenas R, Vargas-Alarcon G, Sanchez-Garcia S, et al. Value of EQ-5D in Mexican city older population with and without dementia (SADEM study). International journal of geriatric psychiatry 2013;29:478-488.
28. Zarate V, Kind P, Chuang LH. Hispanic valuation of the EQ-5D health states: a social value set for Latin Americans. Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research 2008;11: 1170-1177.
29. Albala C, Lebrao ML, Leon Diaz EM, et al. [The Health, Well-Being, and Aging (“SABE”) survey: methodology applied and profile of the study population]. Revista panamericana de salud publica = Pan American journal of public health 2005;17:307-322.
30. Colombian-Congress. Republic of Colombia, Estratos y Metodologia. In: Colombia Ro, ed. Law 142, article 102. Colombia1994.
31. Brunsvold MA. Pathologic tooth migration. Journal of periodontology 2005;76:859-866.
32. Nibali L, Farias BC, Vajgel A, Tu YK, Donos N. Tooth loss in aggressive periodontitis: a systematic review. Journal of dental research 2013;92:868-875.
33. Boehm TK, Scannapieco FA. The epidemiology, consequences and management of periodontal disease in older adults. Journal of the American Dental Association 2007;138 Suppl:26S-33S.
34. Bignozzi I, Crea A, Capri D, Littarru C, Lajolo C, Tatakis DN. Root caries: a periodontal perspective. Journal of periodontal research 2013.
35. Gonzalez Sanz AM, Gonzalez Nieto BA, Gonzalez Nieto E. [Dental health: relationship between dental caries and food consumption]. Nutricion hospitalaria 2013;28 Suppl 4:64-71.
36. Colombia Ro, Salud Md, Consultoria. CNd. III Estudio nacional de salud bucal - ENSAB III. In: Salud Md, ed. ENSAB III. Vol VII. Republic of Colombia1999.
37. Fuentes-Garcia A, Lera L, Sanchez H, Albala C. Oral health-related quality of life of older people from three South American cities. Gerodontology 2013;30:67-75.
38. Musacchio E, Perissinotto E, Binotto P, et al. Tooth loss in the elderly and its association with nutritional status, socio-economic and lifestyle factors. Acta odontologica Scandinavica 2007;65:78-86.