



Logistic Regression Analysis of Tooth Loss in a Brazilian Subpopulation

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Authors' contributions

This work was carried out in collaboration between all authors. Authors JPW, ACSB and CBRBS took part in the data analysis and composition of the article. Authors ABLN, MMVBV and EPS took part in the analysis and discussion of the data and the composition of the article. Authors AFCJ and AR took part in the project conception, revision and composition of the article.

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ABSTRACT

Aims: Evaluating the prevalence of tooth loss, edentulism, prosthetic rehabilitation needs and the use of dental prosthesis as well as determine associations between tooth loss and age, sex, economic classification and race of the population studied.

Methodology: A cross-sectional study was conducted with 776 patients aged 15 years old or older seeking public health care at Family Health Units in the city of Recife (northeastern Brazil). Tooth loss was evaluated through an intraoral examination and categorized as 1) a maximum of 12 teeth lost or 2) more than 13 teeth lost.

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Results: Prevalence rates were 85.3% for tooth loss, 5.5% for edentulism and 29% for more than 13 teeth lost. The prevalence rates for the use of maxillary and mandibular dental prostheses and the need of prosthetic rehabilitation were 35.7%, 8.9% and 85.3%, respectively. Binary logistic regression provided the following p-values: < 0.001 for age, 0.449 for sex, 0.043 for economic classification and 0.983 for race. The outcomes were not significantly associated with race or sex.

Conclusions: The prevalence of tooth loss, edentulism and the need of prosthetic rehabilitation were considered high in the population studied and were strongly associated with a low income and an older age. The prevalence of the use of dental prostheses was considered low. Sex and race exerted no influence on tooth loss.

Clinical Relevance: A better understanding of tooth loss will allow dentists to comprehend the etiological factors of this outcome, with a consequent reduction in its prevalence, thereby benefiting the population.

Keywords: Tooth loss; edentulism; epidemiology; logistic regression analysis.

1. INTRODUCTION

For many years, public oral health services available to the Brazilian population were essentially characterized as restorative, mutilating and costly, with a low degree of coverage and low epidemiological impact, what explains the high rates of tooth loss and considerable need for some type of dental prosthesis in the country. According to the 2010 Oral Health Brazil epidemiological survey [1], the "missing" component corresponded to 44.7% of the decayed, missing and filled teeth (DMFT) index in the age group between 35 and 44 years old, with this percentage reaching as high as 91.9% among individuals aged 65 to 74 years. Moreover, 32.8% of the population aged 35 to 44 years used some form of dental prosthesis in the maxillary arch, with this figure reaching 76.5% among individuals aged 65 to 74 years. A total of 10.1% of the population between 35 and 44 years and 53.9% of those aged 65 to 74 years used some form of dental prosthesis in the lower arch. Furthermore, 68.8% of the population aged 35 to 44 years and 92.7% of those between 65 and 74 years required some dental prosthesis in maxillary or mandibular arch.

According to data on the northeastern region of Brazil from the same survey [1], the "missing" component corresponded to 53.7% of the DMFT index in the group aged 35 to 44 years and 92.6% of individuals aged 65 to 74 years. Moreover, 37.6% of the population aged 35 to 44 years used some form of dental prosthesis in the maxillary arch, with this figure reaching 68.6% among individuals aged 65 to 74 years. A total of 11.2% of the population between 35 and 44 years and 44.5% of those aged 65 to 74 years used some form of dental prosthesis in the lower arch. Furthermore, 78.9% of the population aged

35 to 44 years and 96.1% of those between 65 and 74 years required some dental prosthesis in maxillary or mandibular arch.

According to Koltermann [2], tooth loss is a major public health problem worldwide that directly and indirectly affects general health, since an unbalanced occlusion exerts an influence on the quality of one's diet. Thus, edentulous individuals consume fewer macronutrients and micronutrients, with a consequently greater risk of cardiovascular disease, physical disability and death. Some authors state that the factors associated with tooth loss are unfavorable socioeconomic conditions, such as a lack of access to dental services, a low level of schooling, a lack of financial resources, residency in rural areas, a lack of knowledge regarding the prevention of adverse oral conditions, an older age, smoking and diabetes [2-5]. According to Souza and Silva [4], other causes of tooth loss are iatrogenic experiences of patients in the past and a fear of pain. Even those who have access to dental treatment are prone to edentulism, since this is also a permanent solution to the issue of oral pain and iatrogenic experiences. The belief that the removal of teeth may be the solution to an oral health problem is also the result of the interaction between cultural and medical concepts. Considering tooth loss to be inevitable and tooth removal as inherent to the practice of dentists are also often cited as causes of tooth loss. The factors associated with the tooth maintenance are being married, practicing moderate or vigorous physical activity and frequent dental appointments [5].

According to Koltermann [2], for the adequate maintenance of chewing function, a minimum of 20 teeth distributed in the upper and lower

arches is needed, which is denominated functional dentition. This functional dentition is part of a practical oral health goal of the World Health Organization, requiring the presence of 20 teeth with esthetic and natural function and no need for dentures.

Tooth loss has a strong effect on an individual's quality of life, reducing chewing and speech functions and possibly leading to nutritional, esthetic and psychological problems, resulting in diminished self-esteem and social integration [6]. Souza and Silva [4] report a consensus regarding the problems experienced as a result of missing teeth, such as functional and psychological aspects, trauma and rejections in interpersonal relationships – all of which are identified as elements faced in the daily life of edentulous people. According to the authors, tooth loss causes feelings of embarrassment, anger, exclusion and incompleteness, as the teeth are considered to be related to youth, beauty and productivity. Therefore, replacement through the use of dentures is considered important to employment, social interactions and cultural relationships as well as exerting an influence on self-esteem.

Assuming the importance of tooth loss to an individual's health, the aim of the present study was to evaluate the prevalence of tooth loss, edentulism, prosthetic rehabilitation needs and the use of dental prostheses. An additional aim was to determine associations between tooth loss and age, sex, economic classification and race in the population of the city of Recife (northeastern Brazil).

2. MATERIALS AND METHODS

The present study was conducted at Family Health Units in different administration districts of the city of Recife (Brazil). A cross-sectional study was conducted to evaluate the health status of the population at a given time based on the evaluation of each member of the group, which results in overall health indicators for the group investigated [7]. Each participant received all explanations regarding the aims of the study and those who agreed to participate or their legal guardians (if less than 18 years old) signed a statement of informed consent. This study received approval from the local institutional review board under process number 0533.0.172.000-11.

The population consisted of individuals aged 15 years or older, with no restrictions regarding sex or race. The sample size was determined using multi-stage sampling, which determined a minimum sample of 776 individuals. All patients aged over 15 with good general and oral health who appeared at randomly selected Family Health Units were included in the study. The exclusion criteria were neurological disorders, an inability to understand or answer the questionnaires, such as cognitive or hearing impairment, and individuals under the age of 18 unaccompanied by an adult.

Tooth loss was the dependent variable. The independent variables were age, sex, economic classification and race. Four examiners participated in the data collection process following training and calibration exercises. Kappa coefficients for inter-examiner and intra-examiner agreement were 0.82 and 0.90, respectively. A dental chart was made for each patient and tooth loss was dichotomized for the purpose of statistical analysis: 1) maximum of 12 teeth lost and 2) 13 or more teeth lost.

Socioeconomic status was determined using the Brazilian Economic Classification Criteria of the Brazilian Association of Research Companies. This classification uses education level of the head of household, number of radios in the home, number of refrigerators, washing machines and color TVs, availability of drinking water and connection to the sewage system, number of rooms in the home (especially the number of washrooms) and the number of cleaning personnel who work in the home. The score varies from zero (poorest) to 46 (richest). A score of 0 to 7 corresponds to Class E, 8 to 13 corresponds to Class D, 14 to 22 corresponds to Class C, 23 to 34 corresponds to Class B and 35 to 46 corresponds to Class A. In 2013 the Brazilian Association of Research Companies changed the categorization. The actual classification is Class A1 and A2 (upper socioeconomic level), B1 and B2 (upper-middle socioeconomic level), C1 and C2 (lower-middle socioeconomic level) and D-E Class (low socioeconomic level). This criterion has a similar approach to the one generally used for the analysis of poverty issues related to the so-called absolute poverty concept and it is based on household per capita income. The lower economic stratum (named E) is comprised of families with household per capita income below (or equal to) a poverty line. The subsequent stratum (D) belongs to families whose household

per capita income is situated between the poverty line and the median of the distribution. Next, the families in class C are those with household per capita income between the median and the ninth decile of the income distribution and, finally, the so-called AB class is composed of families with household per capita income above the ninth decile [8].

Statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS, version 17.0). The Shapiro-Wilk test was used to determine the distribution of the data (normal or non-normal). Categorical variables were analyzed using Pearson's chi-square test. Nonparametric variables (age and economic classification) were analyzed using the Mann-Whitney test. Logistic regression was performed to determine the strength of the variables as well as risk and protective factors for tooth loss. Variables with p -value < 0.05 remained in the final model. The level of significance adopted was 99%.

3. RESULTS

A total of 776 individuals participated in the present study. Mean age was 39.88 ± 14.34 years (range: 15 to 70 years; median: 39 years) and 46.6% were between 25 and 46 years of age. The female gender accounted for 84.5% of the sample. A total of 89.2% belonged to economic classes C and D.

Table 1 displays the prevalence rates of tooth loss, edentulism, the use of dental prostheses and the need for prosthetic rehabilitation. The prevalence of tooth loss in the population studied was 85.3%, with 29% corresponding to individuals who lost more than 13 teeth.

Statistically significant associations were found among the outcome and age, economic classification and DMFT index. No significant associations were found regarding gender or race (Table 2).

Table 3 displays the results of the logistic regression, in which both age and economic classification were considered risk factors for tooth loss.

4. DISCUSSION

According to Cimões et al. (2007) [9], tooth loss rates are to dentistry as mortality rates are to medicine and require the knowledge to assist the

planning of healthcare services. Considering the prevalence rates of the missing component of the DMFT index between the 2003 [10] and 2010 [1] Brazilian Oral Health Surveys for the northeastern region of the country, a positive change was found in the group aged 35 to 44 years old (reduction from 71.87% to 53.7%, respectively), whereas no significant change occurred in the age group from 65 to 74 years (92.41% and 92.6%, respectively). The present study found similar values in the groups aged 35 to 44 years old (63.13%) and 65 to 74 years old (91.83%). According to our results and comparing them to the survey in 2010, people are still losing teeth in the same proportion.

In the literature, the most cited causes for edentulism are a lack knowledge regarding preventive care [4,11], difficult access to oral health services [3,4,6,12-15], low income [3-6,9, 11-17], a fear of pain [3,4,12,17,18], a low level of schooling [3-6,11,14,15,17-21], the female sex [3,11,14,15], undergoing treatment at a public dental service [3,15,17], a non-Caucasian ethnicity [5,14,15,19] and an older age [3,5,11,14,16-18,22]. The results of the present study are in agreement with these findings in terms of age, but not in terms of sex or race, as no statistically significant associations were found between the outcome (tooth loss) and these variables. With regard to race, most studies that report a statistically significant difference were conducted in countries where miscegenation is not as intense as it is in Brazil, which may explain the divergence in the results of previous studies and the present investigation. Other authors have also disagreed regarding the association between being non-Caucasian [5,11,14] and tooth loss, since a poorer socioeconomic status is more prevalent in the non-white portion of populations, which can be seen as a confounding variable.

In the present study, the prevalence of at least one missing tooth was similar to that of previous studies conducted in Brazil, China and Vietnam [16,20,23]. The prevalence of edentulism was similar to that of the study conducted in a province of China (4%) [23], but much lower than that of the other study conducted in Brazil (17.8%) [20]. These figures indicate that extraction remains the main procedure adopted to address the oral health problems in these countries and is likely due to the low income and low level of schooling among the largest portion of individuals in these populations [9,18,19].

The findings of the present study are in agreement with data described by Saliba [20] regarding the association between an increase in age and the need for prosthetic rehabilitation, which occurs for cultural reasons [4,18] as well as issues regarding low income and low levels of schooling. The prevalence of use of dental prostheses in the study of Zhang [24] was 38%, which was very similar to the rate found in the present investigation (35.7%).

Although income *per se* was not directly addressed herein, the Brazilian economic classification includes income in its calculation. The economic classification is an important tool for determining the purchasing power of an

individual or family. Therefore, the present findings are in agreement with data described in the literature regarding the association between economic status and tooth loss [3-6, 12-16, 19]. Based on the logistic regression, individuals aged 60 years or older are 15-fold more likely to have greater tooth loss and an economic classification denoting greater privilege was a protective factor for tooth loss, meaning that poorer older individuals are more likely to suffer from tooth loss and edentulism. Although the B and C (middle) economic classes contain a larger number of people, the group with the greatest prevalence rate of tooth loss was the DE class.

Table 1. Prevalence rates of tooth loss, edentulism, use of dental prosthesis and need for prosthetic rehabilitation in population studied

Variables	N	%
Tooth loss one or more unities (with the exception of the third molars)	662	85.3
Edentulism	43	5.5
Tooth loss of 13 teeth or more	225	29.0
Need of prosthetic rehabilitation	662	85.3
Use of superior arch dental prosthesis	277	35.7
Use of inferior arch dental prosthesis	69	8.9

Table 2. Association of tooth loss and other variables studied

Variables	Maximum loss of 12 teeth (N)	13 or more lost teeth (N)	p-values
Age			
• ≤ 34 years	96.5% (299)	3.5% (11)	< 0.001
• 35-59 years	47.9% (187)	52.1% (203)	
• ≥ 60 years	15.8% (12)	84.2% (64)	
Gender			
• Male	63.3% (76)	36.7% (44)	0.837
• Female	64.3% (422)	35.7% (234)	
CCEB index			
• A	66.7% (2)	33.3% (1)	< 0.001
• B/C	68.4% (389)	31.6% (180)	
• DE	52.5% (107)	47.5% (97)	
Race			
• White	64.7% (86)	35.3% (47)	0.921
• Other	64.1% (412)	35.9% (231)	
DMF-T			
• 0 – 2	100% (23)	0,0% (0)	< 0.001
• 3 – Up	63.1% (475)	36,9% (278)	

Table 3. Logistic regression of the studied variables

	Equation variables							
	B	S.E.	Wald	df	Sig.	Exp(B)	95% of C.I. for EXP(B)	
							Lower	Higher
Age	0.137	0.010	187.402	1	.000	1.147	1.125	1.170
Gender	0.212	0.279	0.574	1	.449	1.236	0.715	2.137
CCEB	0.433	0.214	4.103	1	.043	1.542	1.014	2.346
Race	- 0.002	0.074	0.000	1	.983	0.998	0.864	1.153
Constant	- 7.773	0.931	69.771	1	.000	0.000		

5. CONCLUSION

The present findings confirm that a history of tooth extraction to resolve the dental problems of older adults has culminated in a high prevalence rate of tooth loss and need for prosthetic rehabilitation in this portion of the population in the city of Recife, Brazil. The prevalence rates of tooth loss, edentulism and the need for prosthetic rehabilitation among the sample studied are considered high and strongly associated with an advanced age and low income, whereas the prevalence rate of denture usage was considered low.

ETHICAL APPROVAL

The whole project including the both informed consent received approval from the Human Research Ethics Committee of the Federal University of Pernambuco, Brazil (number: 0533.0.172.000-11). All participants signed a statement of informed consent. For those under 18 years of age, an informed consent to perform the examinations came from the parents or guardians properly signed. This research has been conducted in full accordance with the World Medical Association Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Brasil, Saúde Md, Saúde SdAa, Saúde SdVe. SB Brasil 2010: Pesquisa Nacional de Saúde Bucal: Resultados principais. 1 ed. Brasil: Ministério da Saúde; 2012;116.
2. Koltermann AP, Giordani JM, Pattussi MP. The association between individual and contextual factors and functional dentition status among adults in Rio Grande do Sul State, Brazil: A multilevel study. *Cad Saude Publica*. 2011;27(1):173-182.
3. Silva DD, Rihs LB, Sousa MaL. Factors associated with maintenance of teeth in adults in the State of São Paulo, Brazil. *Cad Saude Publica*. 2009;25(11):2407-2018.
4. Silva ME, Magalhães CS, Ferreira EF. Dental loss and prosthetic replacement expectation: Qualitative study. *Cien Saude Colet*. 2010;15(3):813-820.
5. Wu B, Liang J, Plassman BL, Remle RC, Bai L. Oral health among white, black, and Mexican-American elders: An examination of edentulism and dental caries. *J Public Health Dent*. 2011;71(4):308-317.
6. Moreira RaS, Nico LS, Tomita NE. Spatial risk and factors associated with edentulism among elderly persons in Southeast Brazil. *Cad Saude Publica*. 2011;27(10):2041-2053.
7. Rouquayrol MZ, Gurgel M. *Epidemiologia & Saúde*. 7ª Ed ed; 2013;738.
8. Paiva GFS, Silva DBN, Feijó CA. Consumption and Socioeconomic Classification in Brazil: A Study Based on the Brazilian Family Expenditure Survey. Paper Prepared for the IARIW-IBGE Conference on Income, Wealth and Well-Being in Latin America; 2013. Available:<http://www.iariw.org/papers/2013/paivapaper.pdf> (Accessed in August 30th 2015).
9. Cimões R, Caldas Jr. AdF, Souza EHAd, Gusmão ES. Influência da classe social nas razões clínicas das perdas dentárias. *Ciência & Saúde Coletiva [Internet]*. 2007;12:1691-1696.
10. Brasil, Saude Md, Saude SdAa, Basica DdA. Projeto SB Brasil 2003: Condições de saúde bucal da população brasileira 2002-2003: Resultados principais. Brasília: Ministerio da Saude. 2004;68.
11. Hugo FN, Hilgert JB, de Sousa MaL, da Silva DD, Pucca GA. Correlates of partial tooth loss and edentulism in the Brazilian elderly. *Community Dent Oral Epidemiol*. 2007;35(3):224-232.
12. Silva ME, Villaça EL, Magalhães CS, Ferreira EF. Impact of tooth loss in quality of life. *Cien Saude Colet*. 2010;15(3):841-850.
13. Silva DD, Held RB, Torres SV, Sousa MaL, Neri AL, Antunes JL. Self-perceived oral health and associated factors among the elderly in Campinas, Southeastern Brazil, 2008-2009. *Rev Saude Publica*. 2011; 45(6):1145-1153.
14. 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 Dent Oral Epidemiol*. 2001;29(5):329-340.
15. Barbato PR, Peres MA. Tooth loss and associated factors in adolescents: A Brazilian population-based oral health

- survey. Rev Saude Publica. 2009;43(1): 13-25.
16. Nguyen TC, Witter DJ, Bronkhorst EM, Truong NB, Creugers NH. Oral health status of adults in Southern Vietnam - A cross-sectional epidemiological study. BMC Oral Health. 2010;10(2):1-11.
 17. Jovino-Silveira RC, Caldas Jr AdF, Souza EHAd, Gusmão ES. Primary Reason for tooth extraction in a Brazilian adult population. Oral Health & Preventive Dentistry [Internet]. 2005;3:151-157.
 18. Jovino-Silveira RC, Caldas JR. AdF, Souza EHAd, Gusmão ES. Razões das Perdas Dentárias nas Cidades de Maceió e Recife, Brasil. Arquivos em Odontologia [Internet]. 2004;40:229-236.
 19. Neidell M, Herzog K, Glied S. The association between community water fluoridation and adult tooth loss. Am J Public Health. 2010;100(10):1980-1985.
 20. Saliba NA, Moimaz SAS, Saliba O, Tiano AVP. Perda dentária em uma população rural e as metas estabelecidas pela Organização Mundial de Saúde. Saúde, Doenças e Políticas de Formação e Atenção [Internet]. 2010;15:1857-1864.
 21. Mendonça BeM, Cimões R, Araújo AC, Caldas AeF, Silva PV. Impact of the existing tooth number on daily performance: Pilot study. Cien Saude Colet. 2010;15(3):621-630.
 22. Andrade FBd, Caldas Jr AdF, Kitoko PM, Zandonade E. The relationship between nutrient intake, dental status and family cohesion among older Brazilians 2011;27:113-122.
 23. Zhang Q, Witter DJ, Bronkhorst EM, Creugers NH. Dental and prosthodontic status of an over 40 year-old population in shandong province, China. BMC Public Health. 2011;11:1-10.
 24. Zhang Q, Witter DJ, Bronkhorst EM, Jia M, Creugers NH. Dental functional status with and without tooth replacement in a chinese adult population. Clin Oral Investig. 2012; 16(4):1251-1259.

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