

Use of oral health services among elderly Brazilians: mediation by tooth loss

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Abstract *The present study analyzed factors associated with the use of oral health services among elderly Brazilians. This was a cross-sectional study with data from the latest National Oral Health Survey (SB Brazil 2010), which considered a sample of 7,619 elderly individuals (65-74 years) for analysis. Structural Equation Modeling (SEM) was used, investigating the association between latent or observed variables, directly or mediated, in relation to the use of oral health services. Least squares estimators adjusted by mean and variance, were used by means of standardized coefficients, and standard error and confidence intervals, by applying the bootstrapping method with 1,500 iterations. Elderly individuals with a higher socioeconomic status, fewer missing teeth, and the presence of impacts of oral health conditions on their lives were directly associated with the outcome. Other factors associated with the mediated use of oral health services among elderly Brazilians included socioeconomic status, gender, age, and the use of prostheses, in addition to finding a correlation between prosthesis use and missing teeth. Tooth loss, along with other factors, played a prominent role in this study regarding the use of oral health services among elderly Brazilians, pointing to the need to expand access to dental prostheses in primary care.*

Key words Oral health, Dental health services, Elderly, Structural equation modeling

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Introduction

The data from the latest National Oral Health Survey, conducted in Brazil in 2010, showed the precariousness of the oral health condition among the elderly, marked by edentulism; the high prevalence of caries and periodontal diseases; as well as the need for prostheses¹. It is well-known that these results are sequelae resulting from oral health care, predominantly in clinical, iatrogenic, and mutilating actions, in addition to exclusionary preventive actions, which did not respond to the needs of the population^{2,3}.

National surveys of oral health conditions within the Brazilian population point to the Ministry of Health's intention to use epidemiological studies as the core strategy in the axis of oral health surveillance⁴. In 2004, the National Oral Health Policy (PNSB, in Portuguese), called "Smiling Brazil", proposed the restructuring of oral health care⁵. Part of the strategy to reduce social inequality in oral health includes: the increase in Oral Health Team (OHT) coverage in the Family Health Strategy (FHS) and stimulus for the restructuring of the care model through improvements fostered by the OHT, as well as oral health surveillance, by enabling the increase in fluoride at the water treatment stations for public supply and the increase in the complete dental care through the Specialized Dental Clinics (CEOs, in Portuguese)⁶⁻⁸. Faced with the demand for the prosthetics rehabilitation service and in the sense of full oral health care, the Ministry of Health began to finance, as of 2005, the Regional Dental Prosthesis Laboratory (LRPD, in Portuguese)⁹⁻¹¹.

Despite all of the efforts to expand access to oral health care, it is clear that only 12.8% of elderly Brazilians routinely use the dental services, while 14.7% of this elderly population have never used these services in their lives. Moreover, 42.3% visited the services, but nearly 3 years ago, with 46.6% of the elderly individuals presenting the need for dental treatment¹. Among the elderly, aged 65 to 74 years, 92.7% needed a dental prosthesis¹. In addition, only one third of this age range, who require full prostheses, received the proper dental care¹. It is also important to remember that tooth loss can generate negative impacts in the quality of life of these individuals regarding their self-esteem, leading to functional, nutritional, and esthetic disorders¹².

In this sense, the opportunity to use oral health services should be understood as an integral part of the process of providing dental care to the individual and should determine the pos-

sibility of maintaining the satisfactory oral health of the patient, leading to a reduction in the harm caused by preventable diseases and in the worsening of oral health conditions that can generate complex and mutilating treatments^{13,14}.

It is also well-known that the use of oral health services is associated with the personal characteristics of each individual, the socioeconomic status, the subjective conditions of health, as well as the characteristics of the oral health services used by the individual¹⁵. The theoretical model established by Andersen and Davidson deserves special attention to analyze the use of dental services, insofar as we consider that contextual characteristics of the health system and personal characteristics interfere in the oral health behavior, making the individual more willing or not to use the oral health services^{16,17}.

Many national and local studies have investigated¹⁸⁻²¹ the factors that determine the use of oral health services among elderly Brazilians, through multiple regression models, but associations involving measurements have still not been properly tested to evaluate this outcome²²⁻²⁴. Therefore, the present study aims to evaluate the direct and mediated association among individual characteristics, socioeconomic status, normative conditions, and subjective conditions of oral health with the use of oral health services among elderly Brazilians through Structural Equation Modeling (SEM).

Methods

Study design and sample

This is a cross-sectional study, conducted using data from the National Oral Health Survey, carried out in 2010¹, called SB Brasil 2010. Following the criteria set forth by the World Health Organization (WHO)^{25,26}, representative samples of the population within determined age ranges and age indexes were interviewed and examined in their homes as regards oral health and demographic and socioeconomic conditions. For the purpose of the present study, the results for the sample of elderly participants (65-74 years) were considered.

Study variables

Outcome variable

The outcome variable "Use of oral health services" was evaluated based on the question: "Have

you ever been to the dentist's office?"; 0-No, 1-Yes, 2-Do not know/did not answer.

Independent variables

- *Individual primary determinants*: This first block consisted of the following variables: gender, skin color identified based on self-reported race, and age. The gender variable was collected with the following response options: 0-Female, 1-Male. The self-reported color/race was answered as 0-White, 1-Yellow, 2-Brown, 3-Black, 4-Indigenous, and age in years, in which the answers ranged from 65 to 74 years.

- *Socioeconomic condition*: This was treated as a latent variable and built into a measurement model with three observed variables: level of education, number of goods, and income. For level of education, the question was "Up to what grade did you study", converting to years of studies completed without failing. The options for answering the number of household goods included up to eleven goods, namely: television, refrigerator, stereo, microwave, telephone, cell phone, washing machine, dishwasher, microcomputer, and number of cars. The income variable was investigated through the question: How much did the family earn in reals, all people together, whose response possibilities on a Likert scale were: 0-Up to 250, 1-251 to 500, 2-501 to 2500, 3-1501 to 1500 4-2501 to 4500, 5-4501 to 9500, and 6- More than 9500

- *Normative oral health conditions*: This consisted of the observed variables: number of missing teeth (0 to 32) and use of dentures (0-Does not use; 1-Uses in 1 jaw; 2-Uses in 2 jaws).

- *Subjective oral health condition*: A latent variable was estimated by the observed variables: self-perception of dissatisfaction with teeth (Regarding your teeth/mouth, you are: 0-Very satisfied; 1-Satisfied; 2-Neither satisfied nor dissatisfied; 3-Dissatisfied; 4-Very dissatisfied) and nine questions about oral health impacts ("Some people have problems that may have been caused by their teeth. Of the following situations, which ones apply to you in the last 6 months?"), for the nine aspects that follow, with answer options (0-No; 1-Yes): Impact 1 - Had difficulty eating because of your teeth or did you feel pain in your teeth when drinking hot or cold liquids?/ Impact 2 - Did your teeth bother you when brushing?/ Impact 3 - Did your teeth make you nervous or irritated?/ Impact 4 - Did you stop going out, having fun, going to parties, outings because of your teeth?/ Impact 5 - Did you stop playing sports because of your teeth?/ Impact 6 - Did you

have difficulty speaking because of your teeth? / Impact 7 - Did your teeth make you feel ashamed to smile or speak?/ Impact 8 - Did your teeth get in the way of studying/working or doing school/work assignments?/ Impact 9 - Did you stop sleeping or slept poorly because of your teeth?

Theoretical model

SEM analysis was used to assess the factors associated with the use of oral health services among elderly Brazilians, with the models being developed in two stages^{27,28}:

1. Measures or measurement model: Preparation of latent variables via Confirmatory Factor Analysis (CFA), based on observed variables.

2. Structural model: Relationships between observed and latent variables in relation to the dependent variable.

SEM included all the relationships established by regressions between latent or observed variables, defined in an *a priori* theoretical model. The hypothetical model is explained in Figure 1.

The observed variables are represented by rectangles, while the latent variables are expressed by ellipses. SEM also enabled the composition of the total effect of the variables in direct effect (direct relationship of one variable on the other) and indirect effect (mediation by another variable), which enables a better understanding of the relationships between variables. The direct effect, indirect effect, and total effect were estimated, which is defined by the sum of the direct and all indirect effects. The direct or indirect effects are represented by arrows pointing the independent variables towards the outcome variable and by bidirectional arrows that indicate a correlation²⁹⁻³¹.

According to the pre-defined theoretical model, the variables that make up the "*individual primary determinants*" block (gender, age, color/race) may present direct associations with the use of oral health services, but may also be indirectly associated or mediated by the observed variables of the "*normative oral health conditions*" block (number of missing teeth and use of prostheses) and the "*subjective oral health condition*" latent variable. The "*socioeconomic status*" latent variable may be directly associated with the use of oral health services or indirectly associated by the variables in the "*normative oral health conditions*" and "*subjective oral health status*" block. The variables that make up the "*normative oral health conditions*" block may be associated with the outcome variable and/or mediated by the "*subjective*

oral health condition” block, which, in turn, may be directly associated with the use of oral health services, according to the suggested model.

Statistical analysis

The categorical variables used in the model were described in absolute (n) and relative (%) frequencies, while the numerical variables were described in mean and standard deviation (SD).

Measurement models were constructed using the CFA under the hypothesis that “socioeconomic status” and “subjective oral health status” are latent variables. The significance of the models was given by the convergent validity of the standardized regression coefficients (β), in which the factor loading greater than 0.5 was considered strong^{22,24}.

At the end, SEM was conducted for the purpose of defining the direct and indirect associations between the outcome variable (use of oral

health services) and independent variables. Least squares estimators adjusted by mean and variance (WLSMV) were used, using standardized coefficients, standard error, and confidence intervals, and the bootstrapping method with 1,500 iterations.

The database was organized in the IBM/Statistical Package for the Social Science SPSS® 24, and Stata® 15 and MPlus® 8 were then used for analysis. For the adequacy of the model, the parameters of the adjustment measures were considered: *Comparative Fit Index* - CFI>0.80³², *Tucker-Lewis Index*, with TLI>0.80^{30,32}, and *Root Mean Square Error of Approximation* RMSEA<0.08^{30,33}.

Ethical aspects

The study was conducted in compliance with the ethical principles of research, approved and registered by the National Research Ethics

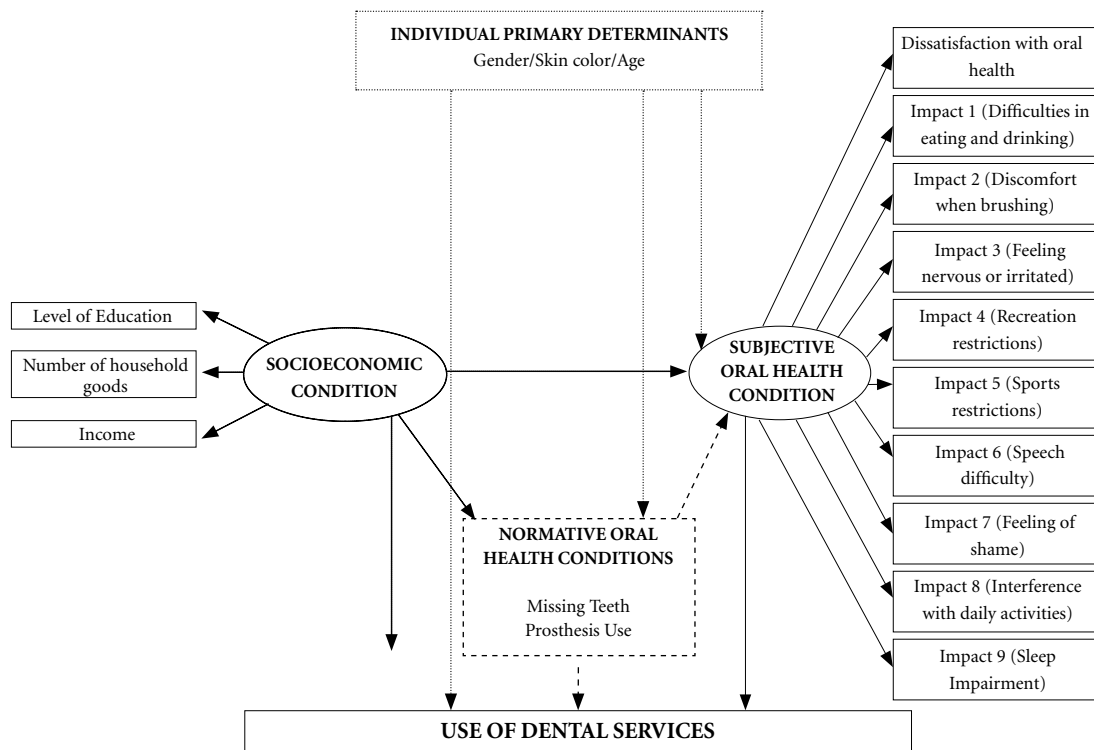


Figure 1. Hypothetical model to be tested to evaluate the “Factors associated with the use of oral health services among the Brazilian elderly”.

Commission (CONEP), logged under number 15498/2010.

Results

A total of 7,619 elderly individuals participated in the study, aged 65 and 74 years, 86.1% of whom had used oral health services throughout their lives. The majority of those who were interviewed were female, with a mean age of 69 years, and self-declared predominantly white skin color. In terms of socioeconomic status, 15.6% of them were illiterate with an income \leq R\$ 1,500 and an average of 6.4 household goods. Only 2% of the elderly did not have any missing teeth in their mouths and most of them used some type of prosthesis. With regard to self-perception of oral health, 48.2% of respondents classified their oral health as regular, poor, or very poor. Regarding the impacts on oral health, 43.9% of the elderly interviewed had had problems with their teeth or mouth in the last six months (Table 1).

Confirmatory Factor Analysis (CFA)

The measurement model for developing the “*socioeconomic condition*” latent variable showed the standardized factor weights of the observed variables: level of education, number of goods, and income. The “*subjective oral health condition*” latent variable was constructed by associating the observed variables with the latent construct. The latent variable measurement models developed by CFA are shown in Figure 2.

Final structural model

The final structural model in Figure 3 represents only the significant direct associations. The goodness of fit indices for this model were: CFI: 0.80; TLI: 0.80; RMSEA: 0.074 (0.07-0.08); $p < 0.01$.

The variables directly associated with the use of oral health services were: “*socioeconomic status*”, “*subjective oral health status*”, number of missing teeth and gender. Elderly individuals with better “*socioeconomic status*” had a higher frequency of use of oral health services ($\beta = 0.19$; $p < 0.01$). A lower number of missing teeth was associated with a higher frequency of use of oral health services ($\beta = -0.15$; $p < 0.01$). Negative self-perception due to oral health was associated with a higher frequency of use of oral health services ($\beta = 0.12$; $p < 0.01$). Men showed a direct

association with the use of oral health services ($\beta = -0.06$; $p < 0.05$), i.e., a lower frequency of use as compared to women.

The “*socioeconomic status*” also showed a direct association with the number of missing teeth, the use of dentures, and the “*subjective oral health condition*”.

In addition to showing a significant direct association with the use of oral health services, “*socioeconomic status*” was indirectly associated with it, mediated by the variable number of missing teeth ($\beta = 0.05$; $p < 0.01$). A correlation was also observed between the use of dentures and missing teeth ($\beta = -0.50$; $p < 0.01$). In addition to the direct effect, gender was indirectly significantly associated with use of oral health services, mediated by the number of missing teeth ($\beta = 0.02$, $p < 0.01$). Age did not present a statistically significant association with the use of oral health services, but it was indirectly associated through the number of missing teeth ($\beta = -0.01$, $p < 0.05$), as well as the use of dentures, and it was indirectly associated with the use through “*subjective oral health status*” ($\beta = -0.01$, $p < 0.05$). Table 2 shows the estimates of direct, indirect (with details of those that had a significant association), and total effects on the use of oral health services, expressed by standardized coefficient (β), standard error (SE), and p value.

Discussion

The present study analyzed the factors associated with the use of oral health services among the elderly based on a representative sample of the Brazilian population¹, with hypotheses established in the defined *a priori* theoretical model, in which direct associations with the use of oral health services were found and, through a differentiated interpretation in relation to other studies that had already investigated this outcome, it was also possible to verify the indirect or mediated associations with the use of oral health services.

The “*socioeconomic status*” latent variable was directly associated with the use of oral health services. It was possible to construct a latent variable for the “*socioeconomic condition*”, with strong effects of the observed variables (income, level of education, and the number of household goods) on the factor, which proved how much the developed latent variable can express such a measure, by the standardized coefficients of correlation being so high, thus confirming the proposed measurement model using the CFA. The associ-

Table 1. Descriptive analysis of the variables observed in the study. SB Brazil, 2010, n=7,619.

Variables	n* (%)/ Mean [SD]
Use of Services	
No	1,058 (13.9)
Yes	6,561 (86.1)
Individual Primary Determinants	
Age (in years)	69.01 [3.13]
Gender	
Female	4,716 (61.9)
Male	2,903 (38.1)
Skin color (self-reported race)	
White	3,577 (46.9)
Yellow/Black/Brown/Indigenous	4,042 (53.1)
Socioeconomic Condition	
Level of Education (years studied)	5.08 [4.35]
No. of household goods	6.41 [2.66]
Family Income (in reais)	
>1,500.00	2,460 (29.5)
≤1,500.00	5,159 (70.5)
Normative oral health conditions	
No. of missing teeth	24.52 [9.46]
Use of prosthesis	
Do not use in any arch	1,810 (23.8)
Use in one arch	2,094 (27.5)
Use in two arches	3,715 (48.8)
Subjective oral health condition	
Dissatisfaction with teeth and mouth	
Very good/Good	605 (7.9)
Good	3,345 (43.9)
Regular	1,394 (18.3)
Bad	2,050 (26.9)
Very bad	225 (3.0)

Table 1. Descriptive analysis of the variables observed in the study. SB Brazil, 2010, n=7,619.

Variables	n* (%)/ Mean [SD]
Impact of oral disorders	
Difficulties eating	
No	5,326 (69.9)
Yes	2,293 (30.1)
Discomfort when brushing	
No	6,723 (88.2)
Yes	896 (11.8)
Feeling nervous or irritated	
No	6,574 (86.3)
Yes	1,045 (13.7)
Recreational activities restrictions	
No	6,967 (91.4)
Yes	652 (8.6)
Sports restrictions	
No	7,388 (97.0)
Yes	231 (3.0)
Speech difficulty	
No	6,411 (84.1)
Yes	1,208 (15.9)
Feeling of shame	
No	6,269 (82.3)
Yes	1,350 (17.7)
Interference with daily activities	
No	7,259 (95.3)
Yes	360 (4.7)
Sleep impairment	
No	6,995 (91.8)
Yes	624 (8.2)

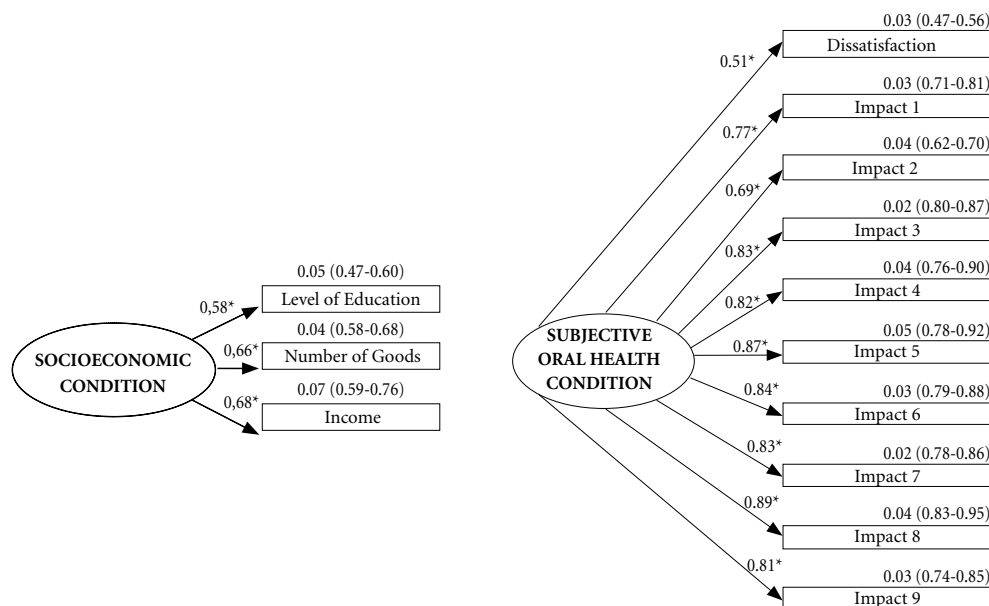
*Missing data were imputed using the averaging technique.
SD: standard deviation.

Source: Authors.

ation of socioeconomic status with the outcome showed that the better the socioeconomic status, the greater the use of oral health services by the elderly. Other studies corroborated this finding, showing that the higher the level of education and income, the greater the recent or routine use of these services^{21,34-36}. A population-based cross-sectional study with elderly people in Pelotas, Rio Grande do Sul, Brazil, found an association between a high level of education and the use of oral health services in the past year³⁷. This can be explained by the fact that education empowers the individual to perceive their health needs and the accessibility to information, in addition to translating socioeconomic aspects and,

therefore, providing opportunities for the use of oral health services, as needed, when there are financial resources for the search and payment. This finding suggests a disadvantage in the use of services among the economically disadvantaged and those with less education.

Another latent variable, the “*subjective oral health condition*”, was also directly associated with the use of oral health services, in addition to mediating the association between the use of dentures and the use of oral health services. It consisted of observed variables that also presented high correlation loads with the factor, including self-perception of dissatisfaction with the mouth or teeth and nine questions of oral



Fit indices - Latent variable Socioeconomic Condition latent variable	Fit indices - Subjective Oral Health Condition latent variable
CFI: 1.0	CFI: 0.98
TLI: 1.0	TLI: 0.97
RMSEA: 0.00 [0.00-0.00]	RMSEA: 0.02 [0.01-0.02]

Figure 2. Measurement model for the composition of the “socioeconomic status” and “subjective oral health status” latent variables with estimated parameters.

CFI: Bentler comparative fit index; TLI: Tucker-Lewis index; RMSEA: root mean square error of approximation. coefficient; EP: Standard error; IC: Confidence interval. *Significant association $p < 0.01$. Impact 1: Difficulty eating and drinking; Impact 2: Discomfort when brushing; Impact 3: Feeling nervous or irritated; Impact 4: Recreation restrictions; Impact 5: Sports restrictions; Impact 6: Speech difficulty; Impact 7: Feeling of shame; Impact 8: Interference with daily activities; Impact 9: Sleep impairment.

Source: Authors.

health impacts on various aspects of the individual's life. Here, the greatest impact was associated with the use of oral health services. It is suggested that it is important that individuals perceive their health problems so they can take care of themselves³⁸. This relationship makes sense in the present study, since the use of oral health services was associated with a negative self-perception of oral health, allowing the individual to seek services motivated by this self-perception. One study corroborates that subjective factors, such as the perceived need for dental treatment and the perception of oral health itself, influence the demand for oral health services³⁹. Conversely,

a study that routinely evaluated the use of oral health services among elderly Brazilians showed that individuals whose oral health has an impact on their lives may seek the service only for curative care or pain relief and not for preventive actions⁴⁰. Yet another study with a representative sample of the Brazilian population showed that the use of dental services is associated with self-perception of oral health among dentate elderly individuals, without indicating whether it is negative or positive⁴¹. Other studies diverged, given that a greater chance of using dental services was associated with both a negative^{21,42,43} and a positive^{21,43,44} self-perception of oral health.

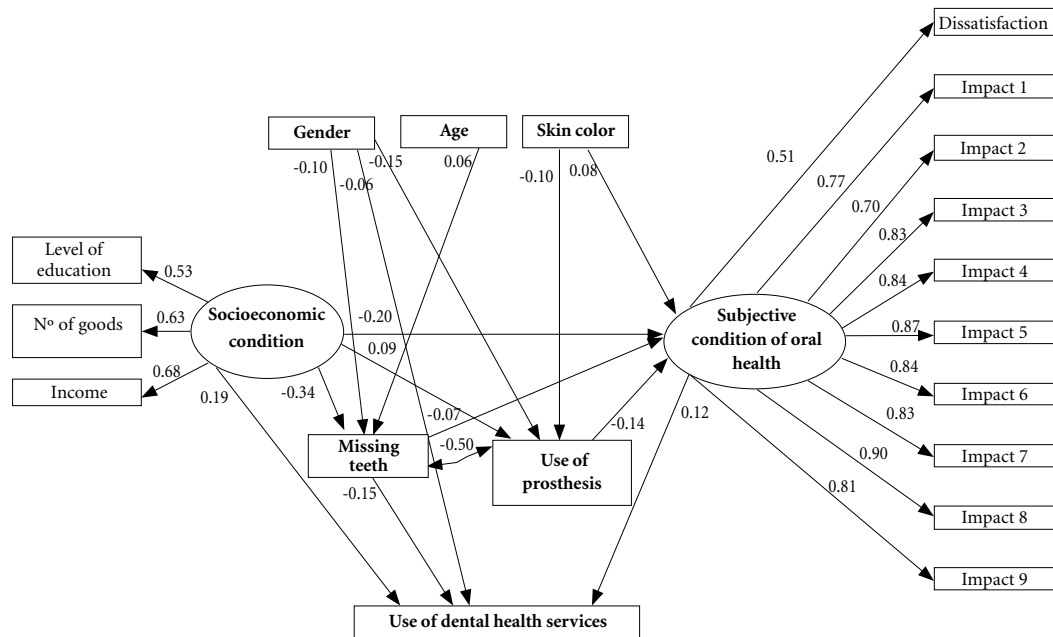


Figure 3. Final structural model for use of dental health services among the elderly.

Source: Authors.

This indicates that the relationship between the perception of oral abnormalities and demand is very personal. A survey conducted in Florianópolis showed that, although 66% of the elderly had lost most of their teeth, 65.2% of them considered the state of their oral health to be good or excellent⁴⁵. Other findings confirm that elderly individuals with a positive self-perception have poor oral health conditions, which, in the light of epidemiology, creates a subjective fallacy that not having teeth is associated with not having oral problems and that those who are not bothered by it will not seek treatment as they do not deem it necessary⁴⁶.

The number of missing teeth variable was highlighted in this study for presenting a direct association with the use of oral health services, already mentioned, mediated (via “*subjective oral health condition*”), mediating (socioeconomic status, gender, and age), and correlated (use of dentures). It was found that the greater the number of missing teeth, the lower the use of services. Data from the United States reveal that tooth loss was more significant among those who had seen the dentist the longest⁴⁷. In Brazil, edentulism is

seen in more than 60% of the elderly⁴⁶. While developed countries have a lower, although still relevant, prevalence, one may infer that tooth loss is a global public health problem^{48,49}, such as South Korea (11%)⁵⁰, and Japan (13.8%)⁵¹. This variation for different countries leaves room to infer that contextual peculiarities interfere with tooth loss⁵². The high prevalence of tooth loss among the elderly has been identified in many studies, more than 35%^{46,53,54}, meaning values that greatly exceed what the WHO recommended for 2010 (5% edentulism among the elderly)⁵⁵.

These results show that elderly Brazilians with missing teeth have a lower use of oral health services and suggest that such use may be being discouraged by the lack of access to dentures. The use of dentures was also indirectly associated via “*subjective oral health conditions*”, with the non-use of dentures being associated with the negative oral health impact on their quality of life. Results suggest the need to provide comprehensive care by making dental prostheses available to those elderly individuals who do not yet have them or need to have them changed. In this regard, it is important to analyze access

Table 2. Direct, indirect, and total effects of observed and latent variables on the use of services among the elderly.

Effects on the use	B	EP	p
Effect on socioeconomic condition			
Direct	0.19	0.04	0.000*
Indirect	0.03	0.02	0.120
Indirect through number of missing teeth	0.05	0.01	0.000*
Total	0.22	0.03	0.000*
Effect on subjective condition			
Direct	0.12	0.03	0.002*
Gender effect			
Direct	-0.06	0.02	0.005*
Indirect	0.02	0.01	0.035
Indirect through number of missing teeth	0.02	0.00	0.000*
Total	-0.04	0.02	0.026
Age effect			
Direct	0.02	0.02	0.528
Indirect	-0.01	0.00	0.000*
Indirect through number of missing teeth	0.01	0.00	0.002*
Total	0.01	0.02	0.939
Effect of number of missing teeth			
Direct	-0.15	0.03	0.000*
Indirect	-0.01	0.00	0.112
Indirect through subjective oral health condition	-0.01	0.00	0.112
Total	-0.16	0.03	0.000*
Effect of using prosthesis			
Direct	0.00	0.03	0.943
Indirect	-0.01	0.07	0.009*
Indirect through subjective oral health condition	-0.01	0.01	0.009*
Total	-0.01	0.03	0.698

*Statistically significant associations $p < 0.05$.

Source: Authors.

to dental prostheses in Brazil. The implementation of Regional Dental Prosthesis Laboratories (LRPD) in the municipalities, through Ordinance No. 1,570/2004⁹, was a relevant strategy aimed at aligning and integrating individual care in the oral health network with this need. This is a Diagnostic Therapeutic Support Service Unit (SADT) whose purpose is to offer total dental prosthesis and removable partial denture services

without restrictions as to the legal entity of the establishment. It so happens that the Ministry of Health transfers a monthly financial amount to municipalities or states to finance accredited LRPDs in compliance with the accredited production range, which may vary from R\$ 7,500 reais (20 to 50 prostheses/month) to R\$ 22,500 (production above 120 prostheses/month)⁵⁶.

Even though the offer of dental prostheses was expanded, only 27% of Brazilian municipalities were accredited in 2015 (meaning 1,477 municipalities with accredited LRPDs in the country)⁵⁷. A 2015 study, which investigated the rates of use and supply of these services, revealed a significant degree of inequality between Brazilian macro-regions in the analyzed period. It concluded that the rise in the number of LRPDs in the country and the production of prostheses seemed discrete, considering the demand for prosthetic rehabilitation⁵⁷⁻⁵⁹, which suggests that production is not being conducted within the scope of primary care (AB) by the OHT of the FHS, with expanded access.

The results of the latest Brazilian epidemiological surveys (1986, 1996, 2003 and 2010) indicate that tooth loss is serious and that edentulism constitutes a public health problem^{1,60}. According to the results of the SB Brasil 2003 national survey, only 10.3% of the elderly population had 20 or more teeth present, with a small change in this percentage in 2010 to 11.5%, indicating a growing need for prosthetic rehabilitation in this population^{1,35,60}. The picture of about half of edentulous individuals remains the same in the elderly, when comparing the 2003 and 2010 surveys^{1,60}. Even considering the advances, social and regional inequalities remain, suggesting the need to adopt universal measures and prioritize the most vulnerable populations to receive priority care⁶¹. Therefore, the inclusion of dental prosthesis procedures in primary care is very important.

According to the Guidelines of the National Oral Health Policy, all basic clinical procedures must be performed in primary care by the OHT, followed by rehabilitation with removable upper, lower, or both total and/or partial dentures¹⁰. Depending on the organization of the municipalities in which primary care does not provide prosthetic rehabilitation, users are referred to Specialized Outpatient Care¹⁰, which can make access difficult due to the lower supply. As the offering of total and partial dentures aims to build a policy of social inclusion of edentulous and partially dentate individuals, minimizing the consequences of mutilating dental practice, the ideal

is that the denture services be closer to them in primary care, by the OHT of the FHS, and with a sizing that truly provided access. However, the technical unpreparedness of dental professionals, the lack of instruments and materials, along with the lack of installed capacity of municipal laboratories or the non-outsourcing of LRPDs, seem to be obstacles to ensuring the full integration of the elderly who are in need of these prostheses.

Gender showed a significant negative direct association with the USSB. Studies have found no difference between the genders with regard to the use of oral health services^{62,63}. A study showed that men were less likely to use services than women, most likely due to a peculiar characteristic of women taking more care in monitoring their health and, therefore, greater demand for health services⁶⁴.

Age was not directly associated with the outcome, but it had a significant indirect effect on the use of services. A previous study³⁷ concluded that younger elderly individuals are associated with use and another one⁶⁴ found that increasing age was associated with never having used oral health services or not having used them for more than one year. A study with a sample from the south of the country found a high prevalence of elderly individuals who did not go to the dentist⁶⁵. The greater use by younger elderly people

can be explained by the greater access to preventive programs, as well as a greater perceived need for health, which motivates them to look for it^{21,64}.

As this is a cross-sectional study, it is not possible to establish causality in the associations found. One potentiality of the study lies in the SEM methodology, which enabled an analysis of mediated associations, in addition to direct ones, thus expanding the use of oral health services' investigation capacity among elderly Brazilians. In addition, it allowed identifying the relevant association that the number of missing teeth variable had in this outcome and how it can guide the organization of services. Studies that include contextual variables with SEM analysis are recommended for this outcome.

This investigation with the use of oral health services among elderly Brazilians showed that tooth loss has a direct association, mediated (via "subjective oral health status"), mediating ("socio-economic status", gender, and age), and correlated (use of dentures). This result points to the need to implement Brazilian oral health policies in order to expand access to oral health services and, above all, to dental prostheses within the scope of primary care, allowing equity, integration, and quality of life for this age group, which continues to grow in Brazil, with serious oral health conditions.

Collaborations

All authors participated in the article's design, planning and definition of the methodology, data analysis and interpretation, and writing of the manuscript.

References

1. Brasil. Ministério da Saúde (MS). *SB Brasil 2010 - Pesquisa Nacional de Saúde Bucal. Resultados Principais*. Brasília: MS; 2012.
2. Moysés SJ, Pucca Junior GA, Paludetto Junior M, Moura L. Avanços e desafios à Política de Vigilância à Saúde Bucal no Brasil. *Rev Saude Publica* 2013; 47(Supl. 3):161-167.
3. Scherer CI, Scherer MDA. Avanços e desafios da saúde bucal após uma década de Programa Brasil Sorridente. *Rev Saude Publica* 2015; 49(98):1-12.
4. Silva NN, Roncalli AG. Plano amostral, ponderação e efeitos do delineamento da Pesquisa Nacional de Saúde Bucal. *Rev Saude Publica* 2013; 47(Supl. 3):3-11.

5. Brasil. Ministério da Saúde (MS). Secretaria de Atenção à Saúde. Departamento de Atenção Básica. 10 anos de Brasil Sorridente: milhões de sorrisos. *Rev Bras Saude Família* 2012; 1(1):74-77.
6. Lucena EHG, Pucca JRGA, Sousa MF. A Política Nacional de Saúde Bucal no Brasil no contexto do Sistema Único de Saúde. *Tempus, Actas Saude Colet* 2011; 5(3):53-63.
7. Brasil. Ministério da Saúde (MS). *Passo a Passo das Ações da Política Nacional de Saúde Bucal*. Brasília: MS; 2016.
8. Organização Pan-Americana de Saúde (OPAS). *A Política Nacional de Saúde Bucal do Brasil: registro de uma conquista histórica*. Brasília: MS; 2006.
9. Brasil. Ministério da Saúde (MS). Portaria nº 1570, de 29 de janeiro de 2004. Estabelece critérios, normas e requisitos para a implantação e credenciamento de Centros de Especialidades Odontológicas e Laboratórios Regionais de Próteses Dentárias. *Diário Oficial da União*; 2004.
10. Brasil. Ministério da Saúde (MS). Secretaria de Atenção à Saúde. Departamento de Atenção Básica. *A saúde bucal no Sistema Único de Saúde*. Brasília: MS; 2018.
11. Brasil. Portaria nº 1.825, de 24 de agosto de 2012. Altera o valor dos procedimentos de prótese dentária na Tabela de Procedimentos, Medicamentos e OPM do SUS e estabelece recursos anuais a serem incorporados ao Teto Financeiro Anual de Média e Alta Complexidade dos Estados, Municípios e Distrito Federal para confecção de próteses dentárias nos Laboratórios Regionais de Próteses Dentárias (LRPD). *Diário Oficial da União*; 2012.
12. Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NHJ. Tooth loss and oral health-related quality of life: a systematic review and meta-analysis. *Health Qual Life Outcomes* 2010; 8:126-136.
13. Austregésilo SC, Leal MCC, Marques APO, Vieira JCM, Alencar DL. Acessibilidade a serviços de saúde bucal por pessoas idosas: uma revisão integrativa. *Rev Bras Geriatr Gerontol* 2015; 18(1):189-199.
14. Fonseca EP, Fonseca SGO, Meneghim MC. Factors associated with the use of dental care by elderly residents of the state of São Paulo, Brazil. *Rev Bras Geriatr Gerontol* 2017; 20(6):785-796.
15. Carreiro DL, Souza JGS, Coutinho WLM, Ferreira RC, Ferreira EF, Martins AMEBL. Uso de serviços odontológicos de forma regular na população de Montes Claros, MG, Brasil. *Cien Saude Colet* 2017; 22(12):4135-4150.
16. Andersen RM, Davidson PL. Ethnicity, aging, and oral health outcomes: a conceptual framework. *Adv Dent Res* 1997; 11(2):203-209.
17. Davidson PL, Andersen RM. Determinants of dental care utilization for diverse ethnic and age groups. *Adv Dent Res* 1997; 11(2):254-262.
18. Peres KG, Peres MA, Boing AF, Bertoldi AD, Bastos JL, Barros AJD. Redução das desigualdades sociais na utilização de serviços odontológicos no Brasil entre 1998 e 2008. *Rev Saude Publica* 2012; 46(2):250-258.
19. Silva AER, Echeverria MS, Custódio NB, Cascaes AM, Camargo MJB, Langlois CO. Regular use of dental services and dental loss among the elderly. *Cien Saude Colet* 2018; 23(12):4269-4276.
20. Oliveira RFR, Souza JGS, Haikal DS'A, Ferreira EF, Martins AMEBL. Equity in the use of dental services provided by the Brazilian Unified Health System (SUS) among the elderly: a population-based study. *Cien Saude Colet* 2016; 21(11):3509-3523.
21. Martins AMEBL, Barreto SM, Pordeus IA. Uso de serviços odontológicos entre idosos brasileiros. *Rev Panam Salud Publica* 2007; 22(5):308-316.
22. Silveira MF, Marôco JP, Freire RS, Martins AMEBL, Marcopito LF. Impact of oral health on physical and psychosocial dimensions: an analysis using structural equation modeling. *Cad Saude Publica* 2014; 30(6):1169-1182.
23. Hair JF, Anderson RE, Tatham RL, Black WC. *Análise multivariada de dados*. 5ª ed. Porto Alegre: Bookman; 2005.
24. Marôco J. *Análise de equações estruturais: fundamentos teóricos, software & aplicações*. 2ª ed. Lisboa: Report Number; 2010.
25. World Health Organization (WHO). *Oral health surveys: basic methods*. Geneva: WHO; 1997.
26. Roncalli AG, Silva NN, Nascimento AC, Freitas CHSM, Casotti E, Peres KG, Moura L, Peres MA, Freire MCM, Cortes MIS, Vettore MV, Paludetto Júnior M, Figueiredo N, Goes PSA, Pinto RS, Marques RAA, Moysés SJ, Reis SCGB, Narvai PC. Aspectos metodológicos do Projeto SBBrasil 2010 de interesse para inquéritos nacionais de saúde. *Cad Saude Publica* 2012; 28(Supl.):s40-s57.
27. Oliveira AA. *Fatores de risco para nascimento pré-termo - uma análise com modelagem de equações estruturais* [dissertação]. São Paulo: Universidade de São Paulo; 2014.
28. Santos JP, Paes NA. Associação entre condições de vida e vulnerabilidade com a mortalidade por doenças cardiovasculares de homens idosos do Nordeste. *Rev Bras Epidemiol* 2014; 17(2):407-420.
29. Malhotra NK, Lopes EL, Veiga RT. Modelagem de Equações Estruturais com utilização do Lisrel: uma visão inicial. *REMark* 2014; 13(2):28-43.
30. Oliveira AA, Almeida MF, Silva ZP, Assunção PL, Silva AMR, Santos HG, Alencar GP. Fatores associados ao nascimento pré-termo: da regressão logística à modelagem com equações estruturais. *Cad Saude Publica* 2019; 35(1):e00211917.
31. Silva AAM, Vasconcelos AGG, Bettiol H, Barbieri MA. Socioeconomic status, birth weight, maternal smoking during pregnancy and adiposity in early adult life: an analysis using structural equation modeling. *Cad Saude Publica* 2010; 26(1):15-29.
32. Bilich F, Silva R, Ramos P. Análise de flexibilidade em economia da informação: modelagem de equações estruturais. *JISTEM* 2006; 3(2):93-122.
33. Garson GD. *Public Information Technology: Policy and Management Issues*. Hershey: Idea Group Publishing; 2003.
34. Martins AMEBL, Barreto SM, Pordeus IA. Características associadas ao uso de serviços odontológicos entre idosos dentados e edentados no Sudeste do Brasil: Projeto SB Brasil. *Cad Saude Publica* 2008; 24(1):81-92.
35. Ferreira CO, Antunes JLF, Andrade FB. Fatores associados à utilização dos serviços odontológicos por idosos brasileiros. *Rev Saude Publica* 2013; 47(Supl. 3):90-97.

36. Silva AER, Langlois CO, Feldens CA. Use of dental services and associated factors among elderly in southern Brazil. *Rev Bras Epidemiol* 2013; 16(4):1005-1016.
37. Sória GS, Nunes BP, Bavaresco CS, Vieira LS, Facchini LA. Acesso e utilização dos serviços de saúde bucal por idosos de Pelotas, Rio Grande do Sul, Brasil. *Cad Saude Pública* 2019; 35(4):e00191718.
38. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? *J Health Soc Behav* 1995; 36(1):1-10.
39. Moreira RS, Nico LS, Sousa MLR. Fatores associados à necessidade subjetiva de tratamento odontológico em idosos brasileiros. *Cad Saude Publica* 2009; 25(12):2661-2671.
40. Martins AMEBL, Haikal DS, Pereira SM, Barreto SM. Routine use of dental services by the elderly in Brazil: the SB Brazil Project. *Cad Saude Publica* 2008; 24(7):1651-1666.
41. Martins AMEBL, Barreto SM, Silveira MF, Santa-Rosa TTA, Pereira RD. Autopercepção da saúde bucal entre idosos brasileiros *Rev Saude Publica* 2010; 44(5):912-922.
42. Araújo CS, Lima RC, Peres MA, Barros AJD. Utilização de serviços odontológicos e fatores associados: um estudo de base populacional no Sul do Brasil. *Cad Saude Publica* 2009; 25(5):1063-1072.
43. Gibilini C, Esmeriz CEC, Volpato LF, Meneghim ZMAP, Silva DD, Sousa MLR. Acesso a serviços odontológicos e auto-percepção da saúde bucal em adolescentes, adultos e idosos. *Arq Odontol* 2010; 46(4):213-223.
44. Camargo MJB, Dumith SC, Barros AJD. Uso regular de serviços odontológicos entre adultos: padrões de utilização e tipos de serviços. *Cad Saude Publica* 2009; 25(9):1894-906.
45. Benedetti TRB, Mello ALSF, Gonçalves LHT. Idosos de Florianópolis: autopercepção das condições de saúde bucal e utilização de serviços odontológicos. *Cien Saude Colet* 2007; 12(6):1683-1690.
46. Moreira RS, Nico LS, Tomita NE, Ruiz T. O risco espacial e fatores associados ao edentulismo em idosos em município do Sudeste do Brasil. *Cad Saude Publica* 2011; 27(10):2041-2053.
47. Giannobile WV, Braun TM, Caplis AK, Doucette-Stamm L, Duff GW, Kornman KS. Patient stratification for preventive care in dentistry. *J Dent Res* 2013; 92(8):694-701.
48. Gilbert GH, Duncan RP, Shelton BJ. Social Determinants of Tooth Loss. *Health Serv Res* 2003; 38:1843-1862.
49. Barbato PR, Nagano HCM, Zanchet FN, Boing AF, Peres MA. Perdas dentárias e fatores sociais, demográficos e de serviços associados em adultos brasileiros: uma análise dos dados do Estudo Epidemiológico Nacional (Projeto SB Brasil 2002-2003). *Cad Saude Publica* 2007; 23(8):1803-1814.
50. Han DH, Khang YH, Choi HJ. Association of parental education with tooth loss among Korean Elders. *Community Dent Oral Epidemiol* 2015; 43(6):489-499.
51. Ito K, Ainda J, Yamamoto T, Ohtsuka R, Nakade M, Suzuki K, Kondo K, Osaka K. Individual- and community-level social gradients of edentulousness. *BMC Oral Health* 2015; 15:34.
52. Barata RB. Epidemiologia social. *Rev Bras Epidemiol* 2005; 8(1):7-17.
53. Peres MA, Barbato PR, Reis SCGB, Freitas CHSM, Antunes JLF. Tooth loss in Brazil: analysis of the 2010 Brazilian Oral Health Survey. *Rev Saude Publica* 2013; 47(Supl. 3):1-11.
54. Gaio EJ, Haas AN, Carrard VC, Oppermann RV, Albandar J, Susin C. Oral health status in elders from South Brazil: a population based study. *Gerodontology* 2012; 29:214-223.
55. Organização Mundial da Saúde (OMS). *Saúde bucal* [Internet]. [acessado 2018 dez 10]. Disponível em: <http://www.opas.org.br/sistema/fotos/bucal.pdf>.
56. Brasil. Ministério da Saúde (MS). Departamento de Atenção Básica. Coordenação Geral de Saúde Bucal. *Nota técnica: credenciamento e repasse de recursos para os Laboratórios Regionais de Próteses Dentárias – LRPD*. Brasília: MS; 2012.
57. Brasil. Ministério da Saúde (MS). *DATASUS tecnologia da informação a serviço do SUS: notas técnicas* [Internet]. Brasília: MS; 2015 [acessado 2018 dez 10]. Disponível em: <http://tabnet.datasus.gov.br/cgi/def-tohtm.exe?sia/cnv/qgmg.def>.
58. Aguiar VR, Celeste CR. Necessidade e alocação de laboratórios regionais de prótese dentária no Brasil: um estudo exploratório. *Cien Saude Colet* 2015; 20(10):3121-3128.
59. Guimarães MRC, Pinto RS, Amaral JHL, Vargas AMD. Desafios para a oferta de prótese dentária na rede de saúde pública. *Rev Odontol UNESP* 2017; 46(1):39-44.
60. Brasil. Ministério da Saúde (MS). *Projeto SB Brasil 2003: Condições de saúde bucal da população brasileira 2002-2003: resultados principais*. Brasília: MS; 2004.
61. Peres MA, Barbato PR, Reis SCG, Freitas CHSM, Antunes JLF. Perdas dentárias no Brasil: análise da Pesquisa Nacional de Saúde Bucal 2010. *Rev Saude Publica* 2013; 47:78-89.
62. Evashwick C, Conrad D, Lee F. Factors related to utilization of dental services by the elderly. *Am J Public Health* 1982; 72:1129-1135.
63. Dolan TA, Corey CR, Howard MA, Freeman E. Older Americans' access to oral health care. *J Dent Educ* 1988; 52:637-642.
64. Matos DL, Lima-Costa MF. Tendência na utilização de serviços odontológicos entre idosos brasileiros e fatores associados: um estudo baseado na Pesquisa Nacional por Amostra de Domicílios (1998 e 2003). *Cad Saude Publica* 2007; 23(11):2740-2748.
65. Baldani MH, Brito VH, Lawder JAC, Mendes YBE, Silva FFM, Antunes JLF. Determinantes individuais da utilização de serviços odontológicos por adultos e idosos de baixa renda. *Rev Bras Epidemiol* 2010; 13(1):150-162.

Article submitted 23/11/2021

Approved 31/01/2022

Final version submitted 02/02/2022

Chief editors: Romeu Gomes, Antônio Augusto Moura da Silva