

## Brazilian Adults Believe that Complete Dentures would be the Solution to the Oral Impacts Caused by Reduced Dentition

Fernanda Lamounier Campos<sup>1</sup>, Ichiro Kawachi<sup>2</sup>, Gabriela Aparecida Caldeira Rhodes<sup>1</sup>, Aline Araujo Sampaio<sup>3</sup>, Loliza Luiz Figueiredo Houry Chalub<sup>4</sup>, Raquel Conceição Ferreira<sup>4</sup>

<sup>1</sup>School of Dentistry, Federal University of Minas Gerais, Belo Horizonte, MG, Brazil.

<sup>2</sup>Chan School of Public Health, Harvard University, Cambridge, MA, USA.

<sup>3</sup>Department of Clinical, Pathology and Dental Surgery, School of Dentistry, Federal University of Minas Gerais, Belo Horizonte, MG, Brazil.

<sup>4</sup>Department of Community and Preventive Dentistry, School of Dentistry, Federal University of Minas Gerais, Belo Horizonte, MG, Brazil.

**Correspondence:** Loliza Luiz Figueiredo Houry Chalub, Federal University of Minas Gerais, Av. Presidente Antonio Carlos, 6627, Belo Horizonte, MG, Brazil. 31270-901. **E-mail:** [lcfigueiredo@ufmg.br](mailto:lcfigueiredo@ufmg.br)

**Academic Editor:** Wilton Wilney Nascimento Padilha

**Received:** 08 May 2020 / **Review:** 19 January 2021 / **Accepted:** 31 August 2021

**How to cite:** Campos FL, Kawachi I, Rhodes GAC, Sampaio AA, Chalub LLFH, Ferreira RC, et al. Brazilian adults believe that complete dentures would be the solution to the oral impacts caused by reduced dentition. *Pesqui Bras Odontopediatria Clín Integr.* 2022; 22:e200087. <https://doi.org/10.1590/pboci.2022.016>

### ABSTRACT

**Objective:** To evaluate the direct and oral impact-mediated association between reduced dentitions and the self-perceived need for complete dentures (CD) in dentate adults. **Material and Methods:** Data from the Brazilian Oral Health Survey (2010) were analyzed. The outcome was self-perceived need for CD. Functional dentition (FD<sub>ClassV</sub>) was defined by the presence of the following criteria: level I -  $\geq 1$  tooth in each arch, level II - 10 teeth in each arch, level III - 12 anterior teeth, level IV -  $\geq 3$  posterior occluding pairs (POPs) of premolars and level V -  $\geq 1$  bilateral POPs of molars. Oral impacts were assessed with Oral Impacts on Daily Performances scale. **Results:** FD<sub>ClassV</sub> was associated with a less self-perceived need for CD both directly and mediated by oral impacts. Dentitions without level V were associated with the outcome mediated by oral impacts. Between individuals with 10 teeth in each arch, self-perceived need for CD was similar for those who had or not anterior teeth and POPs. Individuals with  $< 10$  teeth in each arch and level III did not have a higher frequency of self-perceived need for CD compared to those with level II. **Conclusion:** Oral impacts mediated the association between reduced dentitions and self-perceived need for CD. Individuals with tooth loss may report need for CD, even when they have dental configurations compatible with functionality.

**Keywords:** Dental Arch; Self Concept; Patient Satisfaction; Dental Prosthesis; Oral Health.

## Introduction

Oral health is a fundamental component of general health, physical and mental wellbeing, as well as the capacity to speak, smile, smell, taste, touch, chew, swallow and transmit a variety of emotions through facial expressions with confidence and without pain, discomfort or disease in the craniofacial complex [1]. Moreover, oral health is influenced by the values, perceptions, expectations, and attitudes of individuals and communities [2].

Patient-centered measures have been incorporated into the assessment of physical, psychological, and social aspects of oral health beyond strictly clinical and normative measures [3]. This approach considers oral health to be a determinant of quality of life [1], and it is important to the investigation of reduced dentitions with an emphasis on the functional components of oral health. Indeed, associations have been found between reduced dentitions and general quality of life [4] as well as oral health-related quality of life (OHRQoL) [3,5]. Reduced dentitions have been assessed using different definitions based on the number or the type, location, and function of remaining teeth [6-9]. However, there is a consensus in the literature that reduced dentitions with the preservation of the anterior teeth and some posterior occlusal units are compatible with the quality of life and satisfaction [3,10]. In contrast, a higher number of missing teeth is associated with a negative perception of oral health [11] and general health [12], as well as the lower general quality of life [4] and OHRQoL [5].

In cases of tooth loss, rehabilitation with complete dentures may be perceived as a definitive solution for oral problems. Studies with a qualitative approach have found that tooth extraction and complete dentures are often perceived as the only solution when tooth loss compromises oral functions, such as chewing, aesthetics, and speech [13]. It is possible that this perception changes depending on the different types of reduced dentition and the occurrence of oral impacts. Analytical epidemiological studies that investigated the direct association between different reduced dentitions and the self-perceived need for complete dentures or whether oral impacts mediate this association were not identified. An analysis also should consider other social determinants of health, considering consistent evidence of the association between socio-demographic characteristics and clinical conditions and perceptions regarding oral health [14,15]. The results of this study could contribute to the identification of priority groups for health promotion actions and more conservative rehabilitative treatment that value the preservation of the remaining teeth throughout life, despite the occurrence of missing teeth. Such strategies could contribute to reducing the prevalence of edentulism among adults and older adults, which is a situation that affects approximately 150 million people around the world [16].

The study hypothesized that adults with dentitions that have fewer functionality criteria in terms of esthetics and occlusion and more oral impacts perceive the need for complete dentures (CD) with higher frequency. Thus, this study aimed to evaluate the direct association and the association mediated by oral impacts between reduced dentitions and the self-perceived need for CD among dentate adults.

## Material and Methods

### Sample and Study Design

A cross-sectional study was conducted using secondary data from the 2010 National Oral Health Survey (SBBrasil 2010) developed by the Brazilian Health Ministry in the five regions of the country [17]. The geographic division of the country into regions was determined by the Brazilian Institute of Geography and Statistics and is adopted in epidemiological studies with a national scope. These regions were part of the

sampling plan with the 27 state capitals (including the Federal District), totaling 32 domains formed by 177 municipalities (the 27 capitals + 30 municipalities in each region). The sample was obtained through a random selection of municipalities and census sectors, characterizing multi-stage cluster sampling with probability proportional to population size [18]. Detailed information on the sample planning can be found elsewhere [18].

The participants were dentate adults between 35 and 44 years of age who did not wear any type of fixed or removable denture. Edentulous individuals and those who wore dentures were excluded because the system adopted for the classification of reduced dentition, which was proposed by Nguyen et al. [9], is based on only natural remaining teeth. Moreover, this exclusion criterion was chosen considering the unavailability of information on satisfaction with one's dentures and, therefore, the impossibility of controlling for the effect of this variable on self-reported perceptions of denture need.

#### Data Collection

Data collection involved oral examinations and interviews using questionnaires addressing demographic and socioeconomic characteristics as well as perceptions regarding oral health. The field teams were formed by examiners who had undergone calibration exercises ( $Kappa > 0.65$ ) and trained annotators. The oral examinations were performed following the guidelines of the World Health Organization (WHO) manual for epidemiological studies [19], using the Decayed, Missing and Filled Teeth (DMFT) index, Community Periodontal Index, and clinical attachment loss for the determination of the dental and periodontal status, respectively. The total number of teeth was determined by the number of teeth present, excluding codes 4 and 5 (missing) and 8 (unerupted) of the DMFT index. A posterior occluding pair (POP) was defined as a unilateral pair of opposing posterior teeth as the pair formed by teeth 16 and 46, for example.

#### Response Variable

The following question evaluated the self-perceived need for CD: "In your opinion, do you need complete dentures or need to exchange your current dentures?" [17], for which the response options were "yes", "no" or "does not know/did not answer". CD wearers were not included in the study, so that the (confounding) possibility of anyone answering the question thinking about a possible exchange of their CDs would not arise.

#### Assessment of Dentition

A dentition classification system proposed by Nguyen et al. [9] was employed for the definition of reduced dentitions. This system consists of five hierarchical levels based on the functionality of the teeth in terms of esthetics and occlusion [9,20]. A functional dentition ( $FD_{ClassV}$ ) [9,20] was recorded when the dentition had all five of the following levels sequentially: Level I – at least one natural tooth in the maxilla and mandible; Level II – at least 10 teeth in each arch to enable nine to 10 pairs of opposing teeth; Level III – all 12 anterior teeth present; Level IV – at least three premolar POPs; and Level V – at least one molar POP bilaterally.

Based on this system, nine categories of reduced dentitions were defined. These categories consider the presence or absence of each one or more of the five hierarchical levels (Table 1). The reference category was defined by the presence of levels I and II, the absence of level III, the presence or absence of levels IV and V. Then, the category of reference was: 10 teeth in each arch, < 12 anterior teeth, presence or absence of > 3

premolar POPs, presence or absence of > 1 molar POP bilaterally. This combination of the levels corresponds to a dentition configuration based only on the number of teeth, without considering tooth type and occlusal functions. For that, it was chosen for comparison with other reduced dentitions considering all or some of the functionality criteria defined by Nguyen et al. [9]. This comparison enables the identification of specific criteria from which an association with a self-perceived need for CD may be found.

**Table 1. Categories of the reduced dentitions based on the combination of presence or absence of the five hierarchical levels of the dental functional classification system [9].**

Criteria of the dental functional classification system proposed by Nguyen et al. [9]	Reference category	Functional dentition (FD <sub>ClassV</sub> )	Categories of the Dentition Configuration							
			Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth	
Level I – at least one natural tooth in the maxilla and mandible;	Present	Present	Present	Present	Present	Present	Present	Present	Present	Absent
Level II – at least 10 teeth in each arch	Present	Present	Present	Present	Absent	Absent	Absent	Absent	Absent	Absent
Level III – all 12 anterior teeth present	Absent	Present	Present	Present	Present	Absent	Absent	Absent	Absent	Absent
Level IV – at least three premolar POPs	Present or absent	Present	Present	Absent	Present or absent	Present	Absent	Absent	Absent	Absent
Level V – at least one molar POP bilaterally	Present or absent	Present	Absent	Present or absent	Present or absent	Present or absent	Present	Absent	Absent	Absent

#### Assessment of Oral Impacts

Oral impacts were assessed using nine items of the Oral Impacts on Daily Performance (OIDP) scale, which is widely used for the evaluation of OHRQoL [21]. The OIDP addresses problems caused by the teeth in the previous six months regarding the following aspects of daily living: eating, cleaning the teeth, affected mood, having fun, practicing physical activities, speaking, smiling without embarrassment, working, and sleeping. Each item has dichotomous response options (0: absence of impact; 1: presence of impact). The oral impact was recorded for any individual who reported that problems with the teeth affected one or more aspects of daily living (OIDP > 1).

#### Covariables

The covariables were demographic characteristics (sex and self-declared skin color/ ethnicity [white, black, brown, yellow/indigenous]), socioeconomic characteristics (income and schooling), perceptions regarding oral health and symptoms (satisfaction with teeth/mouth and reports of dental pain in the previous six months) and clinical variables (gingival bleeding, calculus, shallow periodontal pocket [4-5 mm] and deep pocket [6 mm]). Income was the sum of monthly family earnings determined in Brazilian currency and converted into American dollars (mean exchange rate in 2010: R\$1.76 = US\$1.00) in the following categories: ≤ US \$ 284, US \$ 285 to US \$ 852, US \$ 853 to US \$ 2557 and > US \$ 2557). Schooling was categorized based on complete years of study (≤ four years, five to eight years, nine to 11 years, and 12 or more years). Satisfaction with the teeth/mouth was assessed using the following question: "Regarding your teeth, would you say you are very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied or very dissatisfied?" The

response options were grouped into satisfied (very satisfied + satisfied) and dissatisfied (neither satisfied nor dissatisfied + dissatisfied + very dissatisfied) [14].

### Statistical Analysis

Descriptive analysis was performed to characterize the sample and obtain the frequency of adults according to the categories of the variables investigated. The chi-square test was used to compare denture wearers (excluded from sample) and non-wearers (included in sample) because differences would imply that the included sample should not be regarded as a random subsample of the full survey sample. Crude and adjusted logistic regression models were then used to estimate the association between reduced dentition and the self-perceived need for CD. The variables maintained in the final multiple model were those for which the association with the response variable was statistically significant ( $p \leq 0.05$ ) or that contributed to the fit of the model and had importance recognized in the literature (sex and schooling). The goodness of fit of the model was evaluated using the Hosmer-Lemeshow test. Finally, variables that remained in the final model were used in a structural equation model to evaluate direct and indirect associations between a reduced dentition and the self-perceived need for complete dentures.

Structural equation modeling consists of a measurement model that establishes how latent constructs are measured and a structural model used to analyze associations between variables. The latent variable (represented by a circle) was obtained through the nine OIDP items using confirmatory factor analysis. The parameters were estimated using weighted least squares and variance estimates. The total effects were estimated, which are composed of both direct effects (a direct path from one variable to another [e.g., reduced dentition  $\rightarrow$  self-perceived denture need]) and indirect effects (path mediated by other variables [e.g., income  $\rightarrow$  self-perceived denture need via oral impacts]). The estimates of the parameters of direct and indirect associations and 95% confidence intervals (CI) were determined using the bootstrapping method with 1500 iterations. The goodness of fit of the model was evaluated using the root mean square error of approximation (RMSEA), the comparative fit index (CFI) and the goodness-of-fit index (GFI). RMSEA  $<0.05$  indicates a strong fit, 0.05 to 0.08 indicates a reasonable fit and  $>0.1$  indicates an inadequate fit. CFI and GFI of 1.0 indicate a complete fit of the model and CFI and GFI  $>0.95$  indicate a good fit.

All analyses were performed using Stata® 15.0 (StataCorp, College Station, Texas, USA) and Mplus® 8.3 (Muthén & Muthén, Los Angeles, California, USA), considering complex sampling and sample weights.

### Ethical Aspects

The SBBrazil 2010 project was conducted in accordance with the standards stipulated in the Declaration of Helsinki and received approval from the National Human Research Ethics Committee (certificate number: 15.498, on January 7th, 2010).

### Results

The total sample was composed of 9547 adults, 24 of whom were completely edentulous and were excluded. Among the dentate individuals, 6083 (63.7%) did not use fixed, partial removable or complete dentures and composed the final subsample of the present study. The excluded group had significantly more women ( $p=0.000$ ), individuals with brown skin color ( $p=0.004$ ), income up to R\$500 ( $p=0.000$ ) and oral impacts (OIDP  $\geq 1$ ) ( $p=0.000$ ).

The majority of adults did not perceive a need for CD (72.2%). The characterization of the included sample is displayed in Table 2. Individuals with a functional dentition (FD<sub>ClassV</sub>), those with oral impacts and those who were dissatisfied with their teeth/mouth comprised the majority of the sample, corresponding to 58.8%, 53.3% and 56.8%, respectively (Table 2).

**Table 2. Distribution of sample according to variables investigated in Brazilian adults.**

Variables	N	% (CI 95%)
<b>Reduced dentition</b>		
10 teeth in each arch, <12 anterior teeth, presence or absence of ≥3 premolar POPs, presence or absence of ≥1 molar POP bilaterally	480	8.24 (6.8-9.9)
<b>Functional dentition (FD<sub>ClassV</sub>)</b>		
10 teeth in each arch, 12 anterior teeth, ≥3 premolar POPs, absence of ≥1 molar POP bilaterally	557	9.1 (7.4-11.1)
10 teeth in each arch, 12 anterior teeth, absence of ≥3 premolar POPs, presence or absence of ≥1 molar POP bilaterally	915	15.4 (13.5-17.4)
Less than 10 teeth in each arch, 12 anterior teeth, presence or absence of ≥3 premolar POPs, presence or absence of ≥1 molar POP bilaterally	299	3.6 (2.8-4.7)
Less than 10 teeth in each arch, <12 anterior teeth, ≥3 premolar POPs, presence or absence of ≥1 molar POP bilaterally	59	0.1 (0.5-1.6)
Less than 10 teeth in each arch, <12 anterior teeth, absence of ≥3 premolar POPs, ≥1 molar POP bilaterally	50	0.5 (0.3-0.7)
Less than 10 teeth in each arch, <12 anterior teeth, absence of ≥3 premolar POPs, absence of ≥1 molar POP bilaterally	284	3.0 (2.2-3.9)
Less than one tooth in each arch	55	0.6 (0.4-1.1)
<b>Self-perceived need for complete dentures*</b>		
No	3,912	72.2 (68.8-75.4)
Yes	1,974	27.8 (24.6-31.2)
<b>Presence of oral impacts</b>		
Absence (OIDP=0)	3,076	46.7 (41.8-51.5)
Presence (OIDP≥1)	3,007	53.3 (48.4-58.1)
<b>Demographic characteristics and socioeconomic characteristics</b>		
<b>Sex</b>		
Male	2,233	38.9 (35.2-42.8)
Female	3,850	61.1 (57.2-64.8)
<b>Skin color</b>		
White	2,626	49.7 (45.6-53.9)
Black	671	10.7 (9.04-12.6)
Yellow	103	1.1 (0.7-1.8)
Brown	2,635	37.5 (33.2-42.1)
Indigenous	48	1.0 (0.5-1.6)
<b>Family income (US)*</b>		
≤ US \$ 284	820	11.8 (9.7-14.1)
US \$ 285 to US \$ 852	2,889	52.2 (47.8-56.6)
US \$ 853 to US \$ 2557	1,185	22.0 (19.2-25.0)
> US \$ 2557	1,041	14.0 (11.4-17.1)
<b>Schooling (in years of study)*</b>		
≤ 4	916	17.4 (14.2-21.2)
5 to 8	1,549	27.1 (24.5-29.9)
9 to 11	1,933	30.9 (27.3-34.8)
≥ 12	1,647	24.6 (20.0-29.7)
<b>Age group (years)</b>		
35-39	3,558	56.7 (53.7-59.6)
40-44	2,525	43.3 (40.4-46.3)
Total	6,083	100.0

Subjective aspects of oral health		
Dental pain*		
No	4,499	70.9 (67.5-73.9)
Yes	1,563	29.1 (26.0-32.4)
Satisfaction with teeth/mouth*		
Satisfied	2,516	43.2 (39.5-47.0)
Dissatisfied	3,535	56.8 (53.0-60.5)
Oral health conditions		
Presence of gingival bleeding		
No	3,262	51.4 (47.1-55.5)
Yes	2,821	48.6 (44.5-52.8)
Presence of calculus		
No	1,884	30.9 (28.1-33.8)
Yes	4,199	69.1 (66.2-71.9)
Presence of shallow periodontal pocket		
No	4,344	71.2 (68.1-74.2)
Yes	1,739	28.8 (25.8-31.9)
Presence of deep pocket		
No	5,733	92.9 (90.4-94.7)
Yes	350	7.1 (5.3-9.6)

\*n $\neq$  6,083; Satisfaction n= 6,051; Dental pain n=6,062; Income n= 5935; Schooling (in years of study) n= 6,045; self-perceived need for complete denture n= 5,886.

Figure 1 displays the proportion of the self-perceived need for CD as well as the mean number of teeth and POPs according to the levels of the dental functional classification system. Among the entire sample, 6028 adults (99%) had at least one tooth in each arch (Level I). The self-perceived need for CD was higher among those with 10 teeth in each arch and with the absence of all anterior teeth (36.1%). Among those with the complete anterior sextant, 23.4% perceived a need for CD. The proportion of self-perceived need for CD was higher among individuals who did not successively meet the criteria of the dental functional classification system (right side of Figure 1). Individuals with a functional dentition (FD<sub>ClassV</sub>) had an average of 28.9 teeth and 7.6 POPs. Those with a dentition that did not meet the criteria for Levels II to V had an average of 16 teeth and 1.2 POPs.

The results of the final multiple logistic regression models demonstrated a significant association between a reduced dentition and the self-perceived need for CD in the presence of the adjustment variables (sex, skin color, income and schooling). Greater self-perceived denture need (61.6% to 79.6%) was found among those whose reduced dentitions were missing all anterior teeth independently of the dentition configuration of POPs (Table 3). Adults with a functional dentition (FD<sub>ClassV</sub>) had a 56% lower chance of perceiving a need for CD (OR = 0.44; 95% CI: 0.28 to 0.70) compared to those with 10 well-distributed teeth, less than 12 anterior teeth and presence or absence of molar and premolar POPs. The odds of the self-perceived need for CD among adults with less than one tooth in each arch was 6.29-fold higher compared to those who had 10 well-distributed teeth in each arch (OR = 6.29; 95% CI: 1.55 to 25.52). A significant association was also found between oral impacts and the self-perceived need for CD. Individuals with OI<sub>DP</sub>  $\geq$  1 had a 107% greater chance of a self-perceived need for CD than those without impact (OI<sub>DP</sub> = 0) (OR = 2.07; 95% CI: 1.51 to 2.85). Skin color and income were also associated with the self-perceived need for CD in the final model. The variables included in the structural equation model were reduced dentition, OI<sub>DP</sub>, skin color and income.

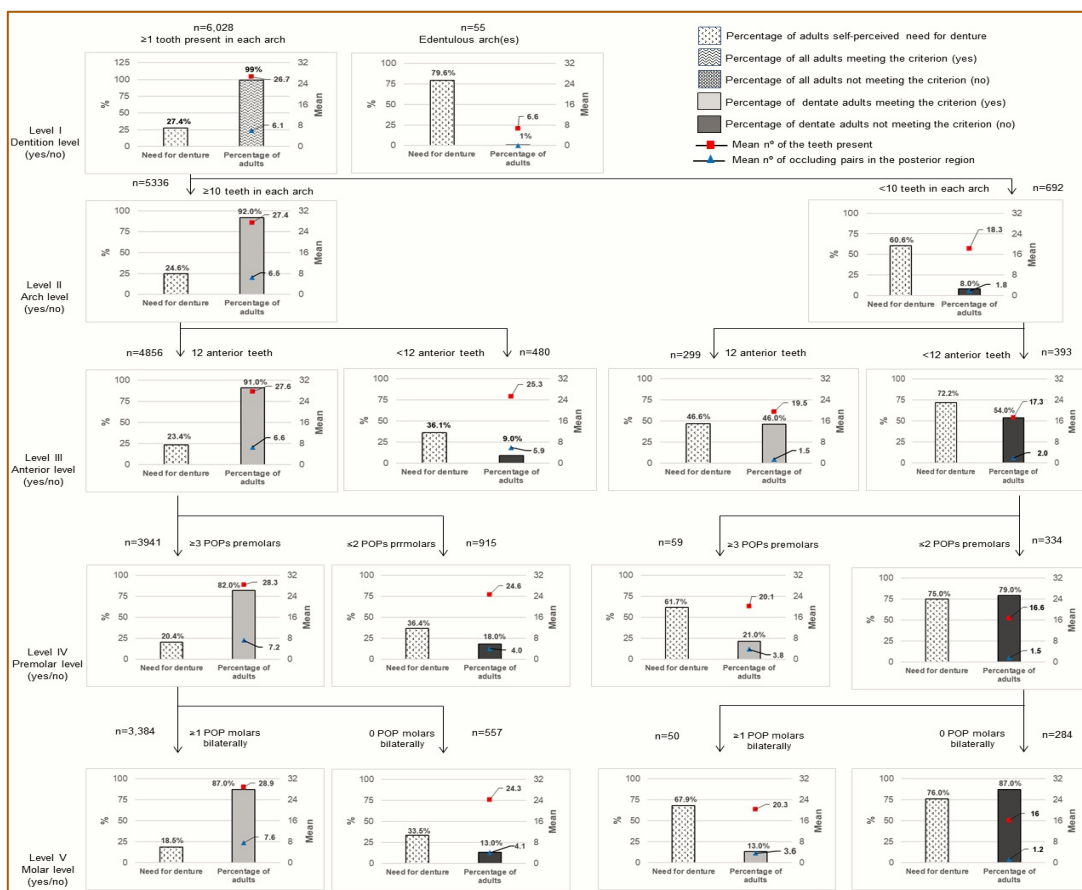


Figure 1. Distribution of individuals according to hierarchical dental functional classification system on five levels. Note: Level I - at least 1 tooth in each arch; Level II -  $\geq 10$  teeth in each arch; Level III - 12 anterior teeth; Level IV -  $\geq 3$  premolar POPs; Level V -  $\geq 1$  molar POP bilaterally. The left side of the figure corresponds to individuals who met the criteria and those on the right side did not meet the criteria.

Table 3. Crude and adjusted logistic regression models of self-perceived need for complete dentures and associated variables in Brazilian adults.

Variables <sup>a</sup>	Categories	n*	% self-perceived need for CD (yes)	Crude OR (95% CI)	p-value	Final Model OR (95% CI)	p-value
Reduced dentition	10 teeth in each arch, <12 anterior teeth, presence or absence of $\geq 3$ premolar POPs, presence or absence of $\geq 1$ molar POP bilaterally	465	36.1	1		1	
	Functional dentition (FD <sub>ClassV</sub> )	3,275	18.5	0.40 (0.26-0.62)	<0.001	0.44 (0.28-0.70)	<0.001
	10 teeth in each arch, 12 anterior teeth, $\geq 3$ premolar POPs, absence of $\geq 1$ molar POP bilaterally	537	33.5	0.89 (0.53-1.51)	0.669	1.03 (0.62-1.71)	0.912
	10 teeth in each arch, 12 anterior teeth, absence of $\geq 3$ premolar POPs, presence or absence of $\geq 1$ molar POP bilaterally	883	36.4	1.01 (0.59-1.75)	0.961	1.05 (0.60-1.82)	0.863
	Less than 10 teeth in	288	46.6	1.55	0.212	1.52 (0.75-3.09)	0.244



	each arch, 12 anterior teeth, presence or absence of $\geq 3$ premolar POPs, presence or absence of $\geq 1$ molar POP bilaterally			(0.78-3.07)				
	Less than 10 teeth in each arch, $< 12$ anterior teeth, $\geq 3$ premolar POPs, presence or absence of $\geq 1$ molar POP bilaterally	57	61.6	2.85 (1.05-7.70)	0.039	3.99 (1.35-11.83)	0.013	
	Less than 10 teeth in each arch, $< 12$ anterior teeth, absence of $\geq 3$ premolar POPs, $\geq 1$ molar POP bilaterally	50	67.9	3.75 (1.34-10.46)	0.012	4.21 (1.34-13.19)	0.014	
	Less than 10 teeth in each arch, $< 12$ anterior teeth, absence of $\geq 3$ premolar POPs, absence of $\geq 1$ molar POP bilaterally	279	76.1	5.63 (2.95-10.76)	$< 0.001$	5.42 (2.80-10.47)	$< 0.001$	
	Less than one tooth in each arch	52	79.6	6.92 (1.90-25.20)	0.003	6.29 (1.55-25.52)	0.010	
Impact	Absence (OIDP=0)	2,993	19.0	1		1		
	Presence (OIDP $\geq 1$ )	2,893	35.5	2.34 (1.70-3.23)	$< 0.001$	2.07 (1.51-2.85)	$< 0.001$	
Sex	Male	2,164	26.8	1		1		
	Female	3,722	28.4	1.08 (0.84-1.40)	0.531	1.02 (0.77-1.35)	0.877	
Skin color	White	2,528	25.1	1		1		
	Black	653	33.1	1.48 (1.06-2.06)	0.021	1.19 (0.82-1.72)	0.360	
	Brown	2,565	28.8	1.21 (0.91-1.59)	0.181	0.90 (0.66-1.24)	0.536	
Family income	Yellow/Indigenous	140	46.4	2.59 (1.38-4.87)	0.003	2.14 (1.05-4.38)	0.037	
	$\leq$ US \$ 284	793	40.9	1		1		
	US \$ 285 to US \$ 852	2,784	29.4	0.60 (0.40-0.90)	0.014	0.81 (0.52-1.26)	0.350	
	US \$ 853 to US \$ 2557	1,156	22.4	0.41 (0.26-0.67)	$< 0.001$	0.68 (0.41-1.12)	0.130	
Schooling	$>$ US \$ 2557	1,021	15.8	0.27 (0.17-0.44)	$< 0.001$	0.50 (0.28-0.90)	0.022	
	$\leq 4$ years of study	883	35.4	1		1		
	5 to 8 years	1,478	30.7	0.81 (0.55-1.19)	0.282	0.94 (0.63-1.42)	0.787	
	9 to 11 years	1,876	28.5	0.73 (0.47-1.12)	0.151	1.31 (0.79-2.16)	0.291	
Dental pain	$\geq 12$ years	1,621	18.2	0.41 (0.27-0.62)	$< 0.001$	0.95 (0.60-1.50)	0.819	
	No	4,376	25.4	1		1		
Satisfaction	Yes	1,498	33.3	1.46 (1.13-1.90)	0.004	1.46 (1.13-1.90)	0.004	
	Very satisfied/Satisfied	2,461	19.2	1		1		
	Neither satisfied nor dissatisfied/Dissatisfied/Very dissatisfied	3,404	34.2	2.19 (1.66-2.90)	$< 0.001$	2.19 (1.66-2.90)	$< 0.001$	
Gingival bleeding	No	3,203	26.2	1		1		
	Yes	2,683	29.4	1.17 (0.83-1.64)	0.362	1.17 (0.83-1.64)	0.362	
Calculus	No	1,857	25.8	1		1		
	Yes	4,029	28.7	1.16 (0.87-1.53)	0.307	1.16 (0.87-1.53)	0.307	
Shallow periodontal pocket	No	4,216	25.7	1		1		
	Yes	1,670	32.8	1.41 (1.02-1.96)	0.036	1.41 (1.02-1.96)	0.036	
Deep pocket	No	5,545	27.2	1		1		
	Yes	341	34.1	1.38 (0.71-2.69)	0.337	1.38 (0.71-2.69)	0.337	

\*total n equal to 5,886 due to missing dependent variable self-perceived need for complete dentures (3,2%). Final model obtained from the adjustment sequence: Model 1 - reduced dentition, satisfaction, impact, pain, gingival bleeding, calculus, shallow periodontal pocket, deep pocket, sex, income, schooling and skin color; Model 2 - reduced dentition, satisfaction, impact, sex, income, schooling and skin color; Final Model - reduced dentition, impact, sex, income, schooling and skin color.

Figure 2 and Table 4, respectively, display the direct and indirect associations between the variables. Having a functional dentition (FD<sub>classV</sub>) was associated with a lower frequency of a self-perceived need for complete dentures directly ( $[\text{Standardized coefficients (SC)}] = -0.250; p < 0.001$ ) and via oral impacts ( $p = 0.003$ ). Having a functional dentition and the reduced dentition category ‘10 teeth in each arch + 12 anterior teeth +  $\geq 3$  premolar POPs and absence of molar POPs’ ( $[\text{SC}] = -0.149; p < 0.001$ ) was also directly associated with a lower OIDP [ $\text{FD}_{\text{classV}} [\text{SC}] = -0.206; p < 0.001$ ]. Reduced dentitions with missing anterior teeth and/or POPs (except for the category ‘less than 10 teeth in each arch, <12 anterior teeth,  $\geq 3$  premolar POPs, presence or absence of  $\geq 1$  molar POP bilaterally’) were associated with a higher frequency of self-perceived need for CD (direct positive association). The category ‘10 teeth in each arch, 12 anterior teeth,  $\geq 3$  premolar POPs, absence of  $\geq 1$  molar POP bilaterally’ was not directly associated with the outcome, but an oral impact-mediated association was found ( $p = 0.002$ ). The coefficients of the latent variable OIDP ranged from 0.688 to 0.882 and a significant direct effect of oral impacts was found on the self-perceived need for CD ( $p = 0.042$ ). Some skin color and income categories had indirect (via oral impacts) effects on the outcome, while direct effects were found only for income US \$ 285–852. These covariates also had significant direct effects on the OIDP (Figure 2 and Table 4).

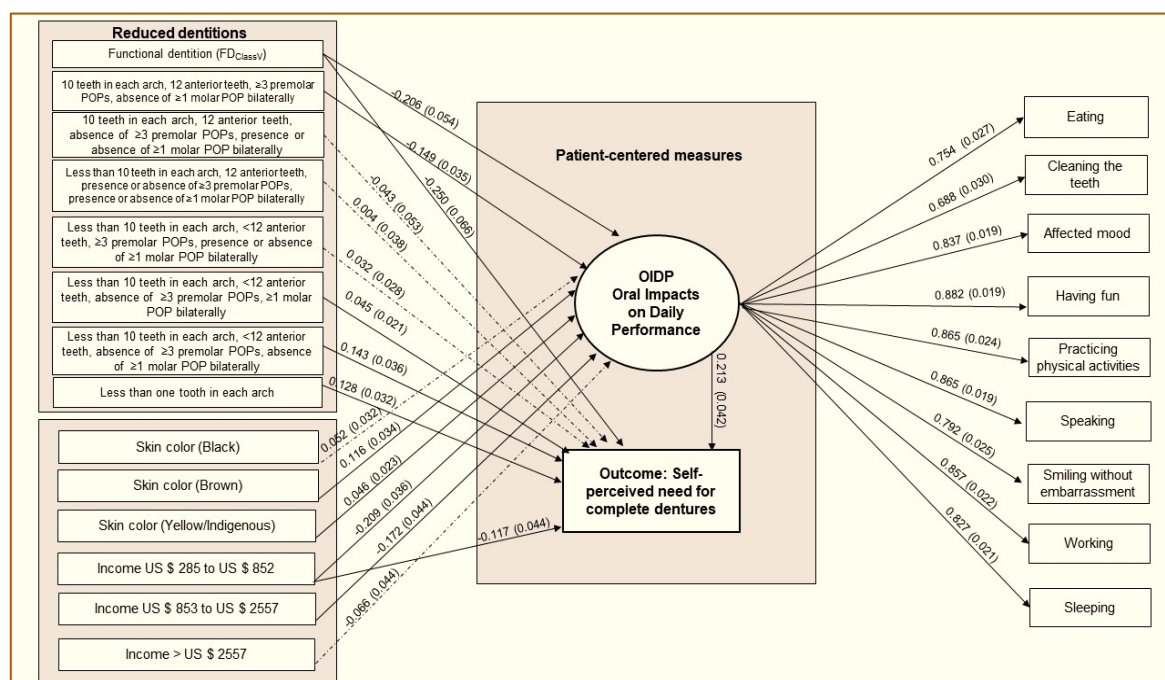


Figure 2. Standardized coefficients (SC) and standard error of direct associations between variables determined by structural equation modeling. SBBrazil 2010. Note: Rectangles represent observed variables and circle represents a latent variable. Dashed arrows correspond to non-significant associations.

Table 4. Standardized coefficients of direct and indirect associations determined by structural equation modeling.

Total and Indirect Effect	SC	SE	p-value
Functional dentition (FD <sub>classV</sub> ) → self-perceived need for complete dentures			
Total	-0.294	0.068	<0.001
Indirect (via OIDP)	-0.044	0.015	0.003
10 teeth in each arch, 12 anterior teeth, $\geq 3$ premolar POPs, absence of $\geq 1$ molar POP bilaterally → self-perceived need for complete dentures			

Total	-0.063	0.051	0.215
Indirect (via OIDP)	-0.032	0.010	0.002
10 teeth in each arch, 12 anterior teeth, absence of $\geq 3$ premolar POPs, presence or absence of $\geq 1$ molar POP bilaterally $\rightarrow$ self-perceived need for complete dentures			
Total	-0.037	0.054	0.495
Indirect (via OIDP)	0.005	0.010	0.610
Less than 10 teeth in each arch, 12 anterior teeth, presence or absence of $\geq 3$ premolar POPs presence or absence of $\geq 1$ molar POP bilaterally $\rightarrow$ self-perceived need for complete dentures			
Total	0.002	0.039	0.958
Indirect (via OIDP)	-0.002	0.007	0.821
Less than 10 teeth in each arch, $<12$ anterior teeth, $\geq 3$ premolar POPs, presence or absence of $\geq 1$ molar POP bilaterally $\rightarrow$ self-perceived need for complete dentures			
Total	0.038	0.029	0.184
Indirect (via OIDP)	0.006	0.005	0.212
Less than 10 teeth in each arch, $<12$ anterior teeth, absence of $\geq 3$ premolar POPs, $\geq 1$ molar POP bilaterally $\rightarrow$ self-perceived need for complete dentures			
Total	0.046	0.020	0.023
Indirect (via OIDP)	0.001	0.003	0.791
Less than 10 teeth in each arch, $<12$ anterior teeth, absence of $\geq 3$ premolar POPs, absence of $\geq 1$ molar POP bilaterally $\rightarrow$ self-perceived need for complete dentures			
Total	0.146	0.038	$<0.001$
Indirect (via OIDP)	0.003	0.006	0.592
Less than one tooth in each arch $\rightarrow$ self-perceived need for complete dentures			
Total	0.132	0.033	0.000
Indirect (via OIDP)	0.005	0.006	0.442
Skin color (Black) $\rightarrow$ self-perceived need for complete dentures			
Total	0.042	0.033	0.208
Indirect (via OIDP)	0.011	0.007	0.118
Skin color (Brown) $\rightarrow$ self-perceived need for complete dentures			
Total	0.003	0.038	0.946
Indirect (via OIDP)	0.025	0.008	0.004
Skin color (Yellow/Indigenous) $\rightarrow$ self-perceived need for complete dentures			
Total	0.052	0.028	0.060
Indirect (via OIDP)	0.010	0.005	0.057
Income US \$ 285 to US \$ 852 $\rightarrow$ self-perceived need for complete dentures			
Total	-0.162	0.043	$<0.001$
Indirect (via OIDP)	-0.045	0.011	$<0.001$
Income US \$ 853 to US \$ 2557 $\rightarrow$ self-perceived need for complete dentures			
Total	-0.116	0.049	0.019
Indirect (via OIDP)	-0.037	0.012	0.001
Income $>$ US \$ 2557 $\rightarrow$ self-perceived need for complete dentures			
Total	-0.081	0.050	0.105
Indirect (via OIDP)	-0.014	0.010	0.142
Goodness of fit: SRMR= 0.052 / CFI= 0.974 / TLI=0.967			

SC = Standardized Coefficient.

## Discussion

Individuals with functional dentition ( $FD_{ClassV}$ ) had fewer oral impacts and a lower frequency of self-perceived needs for complete dentures. Oral impacts mediated the association between a reduced dentition and the self-perceived need for CD. This mediation indicates that aspects of daily living related to the teeth and mouth should be addressed to better understand the self-perceived need for CD and should be considered when developing educational actions directed at adults to preserve the teeth and their functions. This finding is consistent with previous evidence of greater satisfaction with oral health and a higher frequency of an absence of impact ( $OIDP = 0$ ) among adults with a functional dentition ( $FD_{ClassV}$ ) [3].

Oral impacts also mediated the association between a reduced dentition characterized by the absence of molar POPs bilaterally and the self-perceived need for CD. Individuals with this type of reduced dentition did not have a higher self-perception of CD needs but reported fewer oral impacts, which, in turn, were associated with the self-perception of the need for CD. The direct negative association between a reduced dentition with an absence of molar POPs and OIDP is consistent with previous findings that a reduced dentition with three premolar POPs, complete anterior region and no molar POPs is sufficient to satisfy the majority of individuals with regards to oral health [22]. In addition, previous studies found that oral impacts did not differ between individuals with reduced dentitions containing anterior teeth and premolars (reduced dental arch) and more complete dentitions [5].

The direct positive association between oral impacts and a self-perceived need for CD also reveals the importance of person-centered care. The self-perception of denture needs by a dentate individual may be the consequence of the impact of the teeth and mouth on aspects of daily living and does not necessarily mean a need for CD defined by the clinical condition. A previous study with the same sample of adults found that the measure of the self-perceived need for CD overestimated the normative need by about 30% [23], demonstrating that this is a measure of little usefulness in the estimation of dental needs. Moreover, the self-perceived denture need may be influenced by cultural aspects, beliefs and values regarding tooth loss, which is often seen as a natural part of aging [13]. The results of the present study show that the loss of a higher number of teeth resulting in reduced dentitions with less than 10 teeth in each arch and no anterior teeth (even in the presence of POPs) was directly associated with a higher frequency of oral impacts and a self-perceived need for CD. Therefore, advanced tooth loss and its impacts may limit the perception of partial dentures as a rehabilitation option for the recovery of function with the preservation of natural teeth.

The frequency of the self-perceived need for CD was similar among individuals with 10 teeth in each arch, independently of the presence/absence of anterior teeth and premolar and molar POPs. These findings suggest that the criterion based on the balanced distribution of teeth ensures the basic functions of chewing and esthetics. The non significant direct association between reduced dentitions with 10 teeth in each arch and OIDP also support this finding. Individuals with “less than 10 teeth in each arch, 12 anterior teeth, presence or absence of > 3 premolar POPs, presence or absence of > 1 molar POP bilaterally” did not have a significantly higher frequency of a self-perceived need for CD compared to those with “10 teeth in each arch, < 12 anterior teeth, presence or absence of > 3 premolar POPs, presence or absence of > 1 molar POP bilaterally”. This finding suggests that the presence of anterior teeth favors a more positive perception of the teeth even when individuals do not have 10 teeth in each arch, which may be explained by the importance attributed to esthetics and the strong associations between the anterior teeth and satisfaction with one's mouth, psycho-functional well being and the absence of impact [3,24,25]. This may be due to the key role the anterior teeth play in the personal image of individuals [26] and their social relations [22], as the frequency of impact on smiling/speaking is lower among those who have complete anterior sextants [3]. The associations involving demographic and socioeconomic characteristics were in the expected direction with the higher self-perceived need for CD and higher impact among disadvantaged groups (brown/yellow/indigenous and low income adults) [5,15].

This study evaluated a sample of Brazilian adults based on the WHO [19] but has limitations that should be considered. The cross-sectional design does not enable the establishment of causal relations or the evaluation of the temporal relationship assumed in the model tested (reduced dentition → oral impacts on daily performance → self-perceived need for CD). Another limitation is the possible selection bias of the participants,







as the exclusion of denture wearers led to a significant loss of the representativeness of the sample. The associations between self-perceived need for CD and skin color, income and oral impacts may have been underestimated due to the profile of the included sample. Moreover, individuals with a complete dentition (35.69%) were included among those classified as having a functional dentition (FD<sub>ClassV</sub>). Such individuals may have an even lower frequency of oral impacts and self-perceived need for CD compared to those that met all the functionality criteria defined by the dental functional classification system even with the loss of one or more teeth. Thus, the association between FD (ClassV) and self-perceived need for CD may be underestimated due to this potential positive effect of a complete dentition. This study was carried out through the analysis of secondary data and, thus, the researchers did not influence the questionnaire used. Considering that the Brazilian adult has a proportion of the lost component of the DMFT of 44.7%, that the CD is the second type of prosthesis most used by this population and it is the only type of dental prosthesis offered by public services [17], the evaluation of self-perception need for CD must be an adequate proxy for self-perception of functional limitations due to missing teeth. On the other hand, in a scenario in which more therapeutic options were available, such as removable partial dentures, the self-perceived need for CD could well be less, and the present results, therefore, may be an overestimation. Tooth loss can impair aesthetics and occlusion, which are essential oral health functions for this age group that represents the Brazilian working class. CD is still the only alternative for oral function rehabilitation for many people, representing a definitive solution for pain relief for missing teeth and other functional limitations presented by these adults. The strengths of the present study include the estimates generated by the statistical analysis, which considered sample weights and the complex sampling design. We used established indices that indicated the goodness of fit of the model to the data when compared to reference values.

The present results suggest that individuals in greater social disadvantage and those with greater tooth loss could benefit from educational approaches that highlight the importance of preserving their natural teeth and oral functions throughout life. Such actions should be accompanied by an increase in access to conservative treatment and rehabilitation with partial dentures. Recognizing the complexity of the subjective aspects of oral health and combining the clinical evaluation with an assessment of oral impacts with a focus on functionality centered on the person is fundamental to integral oral care contextualized to the social situation of each individual.

## Conclusion

Oral impacts mediated the association between reduced dentitions and self-perceived need for CD. Individuals with tooth loss may report need for CD, even when they have dental configurations compatible with functionality.

## Authors' Contributions

FLC		<a href="https://orcid.org/0000-0002-4772-8088">https://orcid.org/0000-0002-4772-8088</a>	Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation, Writing - Original Draft and Writing - Review and Editing.
IK		<a href="https://orcid.org/0000-0001-9339-2821">https://orcid.org/0000-0001-9339-2821</a>	Methodology, Formal Analysis, Investigation and Data Curation.
GACR		<a href="https://orcid.org/0000-0002-7111-6567">https://orcid.org/0000-0002-7111-6567</a>	Conceptualization, Methodology, Formal Analysis, Investigation and Data Curation.
AAS		<a href="https://orcid.org/0000-0002-8704-5994">https://orcid.org/0000-0002-8704-5994</a>	Conceptualization, Methodology, Formal Analysis, Investigation and Data Curation.
LLFHC		<a href="https://orcid.org/0000-0002-0892-9047">https://orcid.org/0000-0002-0892-9047</a>	Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation, Writing - Original Draft and Writing - Review and Editing.
RCF		<a href="https://orcid.org/0000-0001-8897-9345">https://orcid.org/0000-0001-8897-9345</a>	Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation, Writing - Original Draft, Writing - Review and Editing and Supervision.
All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.			

## Financial Support

The National Council for Scientific and Technological Development (CNPq) (Grant of a master's scholarship to the student FLC), the Coordination of Improvement of Higher Education Personnel (CAPES, participation of RCF in the Visiting Abroad program-PVEX 88881.172365/2018-01), the Research Foundation of the State of Minas Gerais (FAPEMIG, Financial support received by RCF in the research program, PPM PPM-00603-18) and the Coordination of Improvement of Higher Education Personnel (CAPES, Currently, grant of a doctoral scholarship to the student FLC).

## Conflict of Interest

The authors declare no conflicts of interest.

## Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

## References

- [1] Glick M, Williams DM, Kleinman DV, Vujicic M, Watt RG, Weyant RJ. A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. *J Am Dent Assoc* 2016; 147(2):915-7. <https://doi.org/10.1016/j.ajodo.2016.11.010>
- [2] Benyamini Y, Leventhal H, Leventahal EA. Self-rated oral health as an independent predictor of self-rated general health, self-esteem and life satisfaction. *Soc Sci Med* 2004; 59(5):1109-16. <https://doi.org/10.1016/j.socscimed.2003.12.021>
- [3] Chalub LLFH, Ferreira RC, Vargas AMD. Influence of functional dentition on satisfaction with oral health and impacts on daily performance among Brazilian adults: a population-based cross-sectional study. *BMC Oral Health* 2017; 17:112. <https://doi.org/10.1186/s12903-017-0402-5>
- [4] Haag DG, Peres KG, Balasubramanian M, Brennan DS. Oral conditions and health-related quality of life: A systematic review. *J Dent Res* 2017; 96(8):864-74. <https://doi.org/10.1177/0022034517709737>
- [5] Ferreira RC, Kawachi I, Souza JGS, Campos FL, Chalub L, Antunes JLF. Is reduced dentition with and without dental prosthesis associate with oral health-related quality of life? A cross-sectional study. *Health Qual Life Outcomes* 2019; 17:79. <https://doi.org/10.1186/s12955-019-1149-2>
- [6] Kennedy E. Partial denture construction. *Dent Items Interest* 1925; 47:23-35.
- [7] Eichner K. Über eine gruppeneinteilung der lückengebisse für der prothetik. *Dtsch Zahnztl Z* 1955; 10:1831-4.
- [8] Käyser AF. Shortened dental arches and oral function. *J Oral Rehabil* 1981; 8(5):457-42. <https://doi.org/10.1111/j.1365-2842.1981.tb00519.x>
- [9] Nguyen TC, Witter DJ, Bronkhorst EM, Pham LH, Creugers NHJ. Dental functional status in a southern Vietnamese adult population — a combined quantitative and qualitative classification system analysis. *Int J Prosthodont* 2011; 24(1):30-7.
- [10] Tan H, Peres KG, Peres MA. Retention of teeth and oral health-related quality of life. *J Dent Res* 2016; 95(12):1350-7. <https://doi.org/10.1177/0022034516657992>
- [11] Lawal FB. Global self-rating of oral health as summary tool for oral health evaluation in low-resource settings. *J Int Soc Prev Community Dent* 2015; 5(Suppl 1):S1-6. <https://doi.org/10.4103/2231-0762.156516>
- [12] Barboza-Solís C, Porrás-Chaverri M, Fantin R. Is tooth loss important when evaluating perceived general health? Findings from a nationally representative study of Costa Rican adults. *Community Dent Oral Epidemiol* 2019; 47(4):358-65. <https://doi.org/10.1111/cdoe.12466>
- [13] Lima de Paula LML, Sampaio AA, Costa JG, Gomes VE, Ferreira EF, Ferreira RC. Courses from tooth loss to successful rehabilitation with denture: feelings influenced by socioeconomic status. *SAGE Open Med* 2019; 7:2050312119874232. <https://doi.org/10.1177/2050312119874232>
- [14] Chalub LLFH, Borges CM, Ferreira RC, Haddad JPA, Ferreira EF, Vargas AMD. Association between social determinants of health and functional dentition in 35-year-old to 44-year-old Brazilian adults: a population-based analytical study. *Community Dent Oral Epidemiol* 2014; 42(6):503-16. <https://doi.org/10.1111/cdoe.12112>
- [15] Vale EB, Mendes ACG, Moreira RS. Self-perceived oral health among adults in Northeastern Brazil. *Rev Saude Publica* 2013; 47(Suppl 3):98-108. <https://doi.org/10.1590/S0034-8910.2013047004893>
- [16] Kassebaum NJ, Bernabe E, Dahiya M, Bhandari B, Murray CJ, Marcenes W. Global burden of severe tooth loss: A systematic review and meta-analysis. *J Dent Res* 2014; 93(7 Suppl):20S-28S. <https://doi.org/10.1177/0022034514537828>
- [17] Brasil. Ministério da Saúde. SB Brasil 2010: Pesquisa Nacional de Saúde Bucal: Resultados Principais. Secretaria de Vigilância em Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Coordenação Nacional de Saúde Bucal. Brasília: Ministério da Saúde; 2011. 92p. [In Portuguese].
- [18] Silva NN, Roncalli AG. Sampling plan, weighting process and design effects of the Brazilian Oral Health Survey. *Rev Saude Publica* 2013; 47(Suppl 3):3-11. <https://doi.org/10.1590/S0034-8910.2013047004362>

- [19] World Health Organization. Oral Health Surveys: Basic Methods. 4<sup>th</sup>. ed. Geneva: World Health Organization; 1997.
- [20] Chalub LL, Ferreira RC, Vargas AM. Functional, esthetical, and periodontal determination of the dentition in 35- to 44-year-old Brazilian adults. *Clin Oral Investig* 2016; 20(7):1567-75. <https://doi.org/10.1007/s00784-015-1637-7>
- [21] Adulyanon S, Vourapukjaru J, Sheiham A. Oral impacts affecting daily performance in a low dental disease Thai population. *Community Dent Oral Epidemiol* 1996; 24(6):385-9. <https://doi.org/10.1111/j.1600-0528.1996.tb00884.x>
- [22] Elias AC, Sheiham A. The relationship between satisfaction with mouth and number and position of teeth. *J Oral Rehabil* 1998; 25(9):649-61. <https://doi.org/10.1046/j.1365-2842.1998.00313.x>
- [23] Nascimento AR, de Andrade FB, César CC. Validity and utility of self-perceived need for dental treatment by adults and elderly. *Cad Saude Publica* 2015; 31(8):1765-74. <https://doi.org/10.1590/0102-311X00150214>
- [24] Damyanov ND, Witter DJ, Bronkhorst EM, Creugers NH. Satisfaction with the dentition related to dental functional status and tooth replacement in an adult Bulgarian population: a cross-sectional study. *Clin Oral Investig* 2013; 17(9):2139-50. <https://doi.org/10.1007/s00784-013-0925-3>
- [25] Nguyen TC, Witter DJ, Bronkhorst EM, Gerritsen AE, Creugers NHJ. Chewing ability and dental functional status. *Int J Prosthodont* 2011; 24(5):428-36.
- [26] Yu SJ, Chen P, Zhu GX. Relationship between implantation of missing anterior teeth and oral health-related quality of life. *Qual Life Res* 2013; 22(7):1613-20. <https://doi.org/10.1007/s11136-012-0314-4>