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Contextual and individual determinants of non-utilization of dental services among  
Brazilian adults

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Keywords: dental health services; socioeconomic factors; health survey; multilevel analysis.  
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## **Abstract**

*Objectives:* To examine the association of contextual and individual determinants with non-utilization of dental services among Brazilian adults.

*Methods:* Data were from adults aged 35-44 years (N = 7265) from the 2010 Brazilian Oral Health Survey (SB Brasil Project). Non-utilisation of dental services was assessed whether the individual has never had a dental visit over the whole life time. Independent variables were selected according to Andersen's behavioral model. Contextual variables included Human Development Index-longevity (HDI-Longevity) (predisposing demographic), HDI-Education and Gini index (predisposing social), integration of oral health teams into Primary Care (enabling health policy), and HDI-Income (enabling financing). Individual data were age and sex (predisposing demographic), ethnicity and schooling (predisposing social), family monthly income (predisposing enabling), perceived dental treatment (perceived need) and decayed teeth (evaluated need). The relationship of contextual and individual variables with non-utilization of dental services was assessed through multilevel logistic regression analysis to estimate odds ratios (ORs) and 95% confidence intervals (95% CI).

*Results:* The prevalence of non-utilization of dental services was 4.7 percent. Adults living in cities with high HDI-Income were less likely to never have a dental visit. The odds of non-utilization of dental services were lower for adults living in cities with high HDI-Longevity. Sex, skin color, dental treatment needs, poor socioeconomic characteristics, perceived dental treatment needs and decayed teeth were also associated with non-utilization of dental services.

*Conclusions:* The results suggest that contextual enabling and predisposing factors, individual socio-demographic and needs-related characteristics influence non-utilization of dental services by Brazilian adults.

*Keywords:* *Dental health services, Socioeconomic factors, Health survey, Multilevel analysis*

## **Introduction**

In the recent decades, the importance of the impact of social inequalities on population health has reemerged and gained contemporary attention worldwide (1). The structural social and political determinants, including public health system coverage, as well as daily living and working conditions, are responsible for a major part of health inequities (1, 2). Access to health care services is a core component of the health system and an essential element to minimize the ill-health gap between the different socioeconomic groups (2).

The fundamental principle of health care systems is to improve population health through meeting people's health needs and providing financial protection against the costs of ill-health among socially deprived groups (3). Utilization of health services represents the health system's functioning, which should promote equal access to health care regardless of the individual social and economic status (4, 5). Access and utilization of dental services are considered key factors to tackle oral health problems through the prevention and management of dental diseases. Notwithstanding, utilization of dental services remains a public health challenge in most countries (6, 7).

Recent systematic reviews have evaluated the role of different demographic and clinical characteristics as well as social inequalities on the regular or preventive utilization of dental services (7, 8). Individuals from ethnic minorities or immigrants and males reported lower utilization of dental services (7). Socioeconomic position indicators, including education, income, and family structure, were also relevant predictors of utilization of dental services (7, 8). In addition, individuals living in urban areas and those from countries with higher human developmental status were more likely to use dental services, emphasizing the relevance of contextual factors (7, 8).

Socioeconomic inequalities have been investigated as significant determinants of dental services utilization (5, 9-12). Data from 70 countries demonstrated that adults from more egalitarian countries have greater use of dental services for their dental needs (11).

Previous research involving European countries showed considerable intra and inter-country socioeconomic inequalities in the use of dental services in the last 12 months by individuals aged 16 years and older (5). Furthermore, income inequality was associated with lack of use of dental care services among European older adults (9, 10). As expected, European countries where dental care was not covered by the public health system showed greater socioeconomic inequalities related to utilization of dental care services (10). Low income, low education and lack of dental insurance coverage were relevant barriers to dental care use among Canadian adults (12).

Dental care is available in Brazil through private and public oral health care services. The latter is offered by the Brazilian national health system named Unified Health System (*Sistema Único de Saúde - SUS*). SUS proposes universal coverage, integral care and equitable access to oral health care. All procedures are free of charge and are available throughout the country. However, access to public dental care remains a challenge for Brazilian people mainly among those from low income background who face limited access to dental care resulting in ongoing unmet needs (13). Although remarkable reductions of inequalities in access and utilization of dental care have been recently described in Brazil, social inequalities of dental care are still large in the country compared to developed countries (14). Previous studies on the determinants of dental services utilization in Brazil focusing on individual-level socioeconomic factors reported similar findings to those conducted in developed countries (15-18). Overall, individuals from low socioeconomic status experienced less utilization of dental services in the previous year (15), greater irregular use of dental services (16) and a higher likelihood of never been to a dental service (17, 18) than those who are better off. The influence of contextual determinants on the utilization of dental services using multilevel analysis has been reported (5, 11, 19, 20). However, the adoption of theoretical models in previous research is scarce (19). The Andersen's behavioral model is a theoretical framework using different dimensions to explore the inequalities in the utilization of health services (21).

According to Andersen's model the predictors of people's behavior related to health care can be assessed considering predisposing (eg. demographic, social and beliefs), enabling (eg. health policies, financing and organization) and needs (eg. perceived and evaluated health condition) characteristics at contextual and individual levels (21).

The aim of this study was to investigate the relationship of contextual and individual characteristics with non-utilization of dental services in middle-aged adults.

## **Methods**

### **Ethics**

The present study is a secondary analysis of the SBBrasil 2010 Project, which was approved by the Brazilian National Council of Ethics in Research, protocol no. 15498, January 7, 2010.

### **Study Population and sampling**

This was a cross-sectional study using secondary data from the last national oral health survey in Brazil (SBBrasil Project) and contextual data of the state capitals and the Federal District. The SBBrasil Project was a nationwide epidemiological survey carried out to characterize the oral health conditions of the population according to different age groups. The total sample consisted of 37,519 individuals from 32 geographic domains, including 26 state capitals, the Federal District and five domains of the interior municipalities of each Brazilian geographical macro-region (North, Northeast, Central-West, Southeast, and South) (22, 23). The population of the state capitals and the Federal District ranged from 228.332 to 11.253.503 in the year 2010.

A multiple stage sampling process was used to select participants with probability proportional to the number of people in each geographic domain. The primary sampling units for each state capitals and for the interior of each geographic region were 30 census tracts and 30 municipalities, respectively. The second stage of sampling included households in the census tracts of each state capital and two census tracts in the

municipalities from the interior. The third stage of sampling was only applied to the municipalities of the interior when households were randomly selected within each of the sectors selected in the previous stage (23). The sample of the SBBrasil Project is assumed to be representative to estimate the oral health indices of the state capitals and the Federal District. Detailed information about the sampling procedures are described elsewhere (23).

The present study included adults aged between 35 and 44 years from the state capitals and the Federal District. Adults from the interior municipalities of the country were excluded since the sample of the SBBrasil Project was representative only of oral health conditions for the state capitals and the Federal District. Of the 10,222 adults invited to participate in the SBBrasil Project, 9,564 agreed to participate (93.6% of response rate). Adults from the interior municipalities ( $n = 2,231$ ) and those with missing data on utilization of dental services ( $n = 68$ ) were excluded. This resulted in a studied final sample of 7,265 adults who were interviewed and examined.

#### Study power calculation

The power of the study was calculated using the method for proportions with cluster randomization (24) considering 253 as the average number of participants per city (range from 146 to 476), intraclass correlation coefficient of 0.311, and maximum difference of the prevalence of non-utilisation of dental services of 19.7% between cities. The study power was estimated to be 99% involving 7,265 adults in 27 cities with a significance level of 5%.

#### Data collection

Individual interviews and dental examinations were carried out in adults' homes by trained fieldwork teams composed of one dentist and an assistant. A structured questionnaire was used to obtain information concerning sociodemographic data, perceived dental treatment need and utilization of dental services. Calibrated dentists registered the oral epidemiological indices of the participants using sterilized instruments

under natural light. There were ten fieldwork teams in each state capital and the Federal District. The attendance in a 32-hour training workshop and calibration study was mandatory to all dentists. The consensus calibration technique was used to evaluate the agreement between each examiner and team consensus. The minimum kappa coefficient accepted was 0.65 (22).

#### Non-utilisation of dental services

The concept of utilization of dental services adopted in this study considered any type of direct contact (eg. dental consultations, hospitalization) or indirect contact (eg. preventive examinations and diagnosis in health services) with dental services (4). According to the Brazilian law, only dentists registered at the Brazilian Federal Dental Council can provide dental care. Non-utilization of dental services was assessed through interviews with adults according to the question: 'Have you ever had a dental visit?' (Yes/No). The participants were informed the question referred to dental visit over the whole life time. Adults who had never visited a dentist were compared to those who visited a dentist at least once.

#### Contextual characteristics

The contextual characteristics were selected according to the Andersen's behavioral model of health services use and were used to measure the predisposing and enabling variables at the state capital level and the Federal District of Brazil in the year 2000 (21). The year 2000 represents a 10-year period interval between the contextual variables and non-utilisation of dental services and therefore an adequate time lag to test this relationship (25). Predisposing contextual demographic was evaluated based on the life expectancy of the city according to the component Longevity of the Human Development Index (HDI) (26). Predisposing social included the component Education of the HDI and the Gini Index. HDI Education refers to average years studied and expected years of schooling for children at the age of starting school life (26). The Gini index measures the degree of inequality in the distribution of income *per capita* in a society, pointing out the income difference between the poorest and the richest. Gini index ranges from 0 to 1,



where zero corresponds to complete equality of income (everyone has the same income) and 1 corresponding to complete inequality (one person holds all the wealth).

The level of integration of oral health teams into primary care services was used to measure enabling health policies. This measure has been considered an indicator of oral health policy related to the provision of oral health care services and was gathered from the public health care system development index (Index of the Development of the Unified Health System) (27). The component Income of the HDI measured by Municipal Gross Income per capita express the purchasing power and living standards and was employed to evaluate enabling financing (26). All contextual variables were categorized into three equal groups according to tertiles of distribution into low, moderate and high.

#### Individual variables

Individual independent variables were selected and grouped according to Andersen's behavioral model of health services (Figure 1) (21). Predisposing demographic variables included age (completed years) and sex. Predisposing social characteristics were ethnicity and education. Self-perception of skin color was employed to assess ethnicity according to the Brazilian Institute of Geography and Statistics. Each individual was asked to describe his/her skin color using the following options: white, yellow, indigenous, brown, and black (28). Education was assessed according to the number of concluded years at school without failure, using the following categories: 0-4 years; 5-8 years; 9- 11 years;  $\geq 12$  years.

Enabling financing was assessed using the monthly family income recorded in Brazilian Reais (R\$) according to the following categories:  $\leq$ R\$ 500; R\$ 501-1.500; R\$ 1.501-R\$ 2.500 and R\$  $>$ 2.500. One Brazilian real corresponded to 0.586 US dollars when the study was conducted.

Participants' self-perception of dental treatment need (Yes/No) was used to register perceived need registered. Normative need was assessed based on the prevalence of one or more decayed teeth measured by the decayed component (D) of the DMFT

index. The clinical examinations followed the WHO guidelines for oral health surveys (29).

#### Data analysis

Initially, the prevalence of non-utilization of dental services and 95% confidence intervals (CI 95%) with sampling weights was estimated according to the individual variables. Multilevel models were used to estimate the variation of non-utilization of dental services across the cities (random effects) and the effects of contextual variables on the non-utilization of dental services adjusted for individual variables (fixed effects).

The variation of non-utilization of dental services at city-level in the null model, unadjusted and multivariable analyses was assessed using the variance and standard error for the outcome (dichotomous measure) at city-level (random effects). The ratio of the variance and the standard error follows a Chi-square distribution with one degree of freedom. Wald statistic was used to evaluate the significance of the variance at city-level in each model. Variance Partitioning Coefficient (VPC) of each model was estimated to indicate the proportion of the variance in non-utilisation of dental services that can be attributed to the differences between cities.

The association of contextual and individual variables with non-utilization of dental services was tested using multilevel Logistic regression using fixed effect models with a random intercept to obtain odds ratio (OR) and 95% CI. The interaction between contextual and individual variables on non-utilisation of dental services was statistically tested. The Log loglikelihood of the models with and without the interaction terms were estimated using multilevel Logistic regression and did not differ (Chi-square test;  $P > 0.05$ ), suggesting no evidence of interaction.

Initially, unadjusted associations between each independent variable and non-utilization of dental services were estimated. Independent variables with a  $P < 0.10$  were selected for multivariable analysis in order to estimate a parsimonious model.

Multivariable multilevel statistical modeling considered two levels according to Andersen's behavioral model of health services (Figure 1) (21). The first model included contextual variables. The second model was composed of individual predisposing variables (demographic and social characteristics). Enabling financing (family monthly income) was inserted in the third model. The fourth model included perceived dental treatment need and evaluated need (dental caries). Independent variables were adjusted for each other in each model.

Colinearity between independent variables of non-utilization of dental services with a  $P < 0.05$  in the unadjusted analysis was tested using the Spearman coefficient correlation. Significant correlation was found between HDI-Income and HDI-longevity ( $\rho = 0.814$ ,  $P < 0.0001$ ). Thus, separate multilevel analyses were conducted for HDI-Income and HDI-longevity and non-utilization of dental services adjusting for individual variables. All statistical analyses were conducted STATA version 12.0, considering the sample weights.

## Results

The prevalence of non-utilization of dental services in the state capitals and the Federal District was 4.7 percent (95 % CI 3.0, 7.3). Nearly half of the study sample was aged between 40 and 44 years. The individual predisposing, enabling and need characteristics of the sample according to non-utilization of dental services is presented in Table 1. Most participants consisted of females (69.9 percent), had white skin color (46.2 percent), 5-8 years of schooling (30.0 percent), and family income between R\$501 and R\$1,500 (51.8 percent). More than 78 percent of the sample reported dental treatment needs, and 57.1 percent had one or more decayed teeth. Non-utilization of dental services was more prevalent in adults with indigenous and black skin color, those with low schooling, those with low family monthly income and those without perceived dental treatment need.

The unadjusted association between contextual and individual variables and non-utilization of dental services is presented in Table 2. The variation of non-utilization of dental services at city-level was statistically significant in all bivariate analyses between contextual variables and non-utilization of dental services ( $P < 0.01$ ). The VPC of the null model suggests that the differences between cities accounted for 31% of the variance in non-utilisation of dental services. Cities with high HDI longevity and high HDI income had a lower prevalence of non-utilization of dental services ( $P < 0.05$ ) in the crude analysis. Females and those who reported perceived dental treatment needs were less likely to never had a dental visit. Low schooling, low family monthly income, and number of decayed teeth were significantly associated with non-utilization of dental services. Ethnicity was also associated with non-utilization of dental services ( $P < 0.05$ ).

The results of the adjusted multilevel multivariate logistic regression analysis on the relationship between the contextual enabling financing variable (HDI-Income) and non-utilization of dental services adjusting for individual variables are presented in Table 3. The variation of the outcome at city level was statistically significant in all models ( $P < 0.01$ ). In model 1, a high HDI income was statistically associated with lower odds of non-utilization of dental services. Individual predisposing and individual enabling variables were inserted and adjusted for the contextual variable in model 2 and model 3, respectively. In the latter, high HDI income, being female, brown skin color category, low schooling and low monthly family income remained statistically associated with non-utilization of dental services. The final model (model 4) incorporated individual perceived and evaluated need variables. Adults living in cities with high HDI income were 67% less likely to never had a dental visit than those living in the cities in the higher tertile (OR = 0.33 95% CI 0.10, 0.97). Females, brown skin color, less schooling, low family income, perceived dental treatment need and decayed teeth remained statistically associated with non-utilization of dental services (Table 3).

The multivariate multilevel logistic regression of the association between contextual predisposing demographic variable (HDI-longevity) and non-utilization of dental services is presented in Table 4. The variation of the outcome at city level was statistically significant in all models ( $P < 0.01$ ). In model 1, participants living in the cities with high HDI-longevity had a lower chance of never had a dental visit. HDI-longevity, sex, skin color and schooling remained associated with non-utilization of dental services in model 2. In model 3, the odds for non-utilization of dental services was statistically lower for adults living in the cities with high HDI-longevity, women those with brown skin color. Adults with lower schooling and low family income showed significantly higher odds of never had a dental visit. All contextual and individual variables remained statistically associated with non-utilization of dental services in the final model (model 4). The odds of non-utilization of dental services was 70% lower among those living in the cities with high HDI-longevity (OR = 0.30 95% CI 0.10, 0.95). Females, brown skin color, less schooling, low family income, perceived dental treatment need and decayed teeth had a greater chance of non-utilization of dental services (Table 4).

## **Discussion**

This study investigated the individual and contextual determinants of non-utilization of dental services among Brazilian adults. The Andersen's behavioral model of health services was empirically tested in a random sample using a multi-level statistical approach (20). Contextual enabling financing (HDI income) and contextual predisposing demographic (HDI longevity) factors were associated with non-utilization of dental services. Furthermore, individual demographic and social predisposing variables (sex, skin color, years of schooling), individual enabling financing (family income) as well as perceived (dental treatment) and evaluated (decayed teeth) need predicted non-utilization of dental services among Brazilian adults.

Adults living in cities with greater indicators of income and longevity were less likely to not have used dental services. The likelihood of non-utilization of dental services was lower among females, adults with brown skin color and those with perceived dental needs. In addition, low schooling, low family income, and decayed teeth increased the odds of non-utilization of dental services. These findings suggest that multiple social-environmental factors and individual sociodemographic and dental needs characteristics are meaningful aspects of utilization of dental services among Brazilian adults. The results also support the socioeconomic inequalities on the utilization of dental services.

The positive aspects of this study include the use of a nationwide representative sample and the use of multilevel statistical modeling which is the appropriate approach to obtain precise estimations of the contextual effects of city-level variables. The adoption of a specific theoretical model supporting the selection of independent variables and the data analysis should also be highlighted.

Previous studies have tested whether contextual social inequality assessed by HDI at country- (5) and municipal-level were associated with dental services utilization in adults (5, 19, 20). While the probability of non-use of dental care was higher among individuals living in European countries with low HDI (5), HDI across the cities in a large state in Brazil showed no statistical significance with the dental visit at least once in life (19). In a more recent study involving the Brazilian state capitals, HDI components combined with contextual poverty measures showed significant association with non-utilization of dental services (20). Even though HDI components are expected to be correlated as observed in this study, they were analyzed in separate since they reflect distinct contextual measures within the Andersen's behavioral model. As a result, we were able to identify that two HDI components (longevity and income) were significantly associated with non-utilization of dental services. A previous study reported that gross domestic product (GDP) per capita, a clear indicator of contextual absolute income, was a significant predictor for use of dental services at country level (11). This finding is in

accordance with our results on the inverse relationship between high HDI income and non-utilization of dental services.

According to our results, contextual enabling health policies were not associated with non-utilization of dental services, which is in accordance with a study that showed no association between density of dentists and non-use of dental care (5). However, previous studies demonstrated that poorer dental service infra-structure and dentist-to-population ratio were associated with lower use of public dental services (11, 19). The possible explanation for this disagreement may refer to the contextual indicator used to assess health policies. The association between Gini index as a contextual predisposing social measure and non-utilization of dental services was not significant in the present study. However, the inverse relationship between Gini index and use of dental services was reported in a research involving 66 countries (11). This finding was unexpected since income inequality in Brazil has been associated with different oral health outcomes (30). One can argue that the negative impact of income inequality on the use of dental services would be important only when countries with large variations of Gini index are analyzed.

Our results on the association of demographic and individual socioeconomic characteristics with utilization of dental services revealed the existence of inequalities in dental care in Brazilian adults. Previous research showing that women (5, 12, 15, 16, 19), people with more education (5, 12, 16, 17, 19) and those with high income (12, 15, 16, 18, 19) are more likely to use dental services are in accordance with our findings. A recent meta-analysis also showed that lower education decreased the odds of dental services utilization while income was not associated with non-utilization of dental services in South and Middle America (7). The latter result was also described in other publications (5, 17). The observed association between greater perception of dental treatment needs and non-utilization of dental services was already reported (16, 19). However, this finding was not confirmed in another study (17).

In this study, decayed teeth and perceived treatment needs were associated with the outcome reinforcing the social inequities in oral health and the persistence of inverse care law. The social gradient between low education, lower income and non-utilization of dental services reported in this study highlights the social inequities in dental care in Brazil. Individuals with low socioeconomic status have worse oral health status than those from a higher social background (30). People from underprivileged groups usually seek dental care in emergency situations such as infection or dental pain. Otherwise, better off people frequently use dental services for check-ups and prevention (31).

Some limitations of this study should be addressed. First, our findings should not be generalized to other age groups and to countries with different socioeconomic characteristics. Second, this was a cross-sectional study which design restricts interpretation of the causal processes. Third, potential predictors of utilization of dental service, including health insurance, occupation, psychosocial factors and social ties were not assessed due to the lack of information. Therefore, Andersen's behavioral model was not fully addressed.

To conclude, the present findings suggest the existence of contextual and individual inequalities in<sup>[1]</sup><sub>SEP</sub> dental services utilization in Brazilian adults. The existing oral health inequalities in the country as well as in other less developed countries can potentially increase if access to dental services would not improve. The expansion of primary and specialized public dental care, as well as inter-sectoral actions to reduce social inequalities, are needed to enhance dental services utilization. Social policies aiming to improve education in different age groups and those focusing on the reduction of income inequality should be on the political agenda.

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Table 1. Prevalence of non-utilization of dental services by individual predisposing, enabling and need characteristics.

Variables	n	%	Non-use of dental services	
			%	95% CI
Individuals				
<i>Predisposing demographic</i>				
Age				
35 - 39	3824	52.5	4.5	2.9-7.0
40 - 44	3441	47.5	4.9	3.0-8.1
Sex				
Male	2396	30.1	6.1	3.8-9.7
Female	4869	69.9	4.1	2.6-6.5
<i>Predisposing social</i>				
Skin color				
White	2938	46.2	3.4	2.0-5.8
Yellow	112	12.5	3.2	0.8-11.7
Indigenous	53	1.0	11.7	2.1-45.0
Brown	3395	39.6	4.1	2.7-6.2
Black	767	0.7	11.1	4.8-23.4
Years of schooling				
≥ 12	1810	21.1	3.6	2.1-6.2
9 - 11	2393	31.6	4.4	2.4-7.8
5 - 8	2008	30.0	6.3	3.3-11.5
0 - 4	1026	17.3	4.0	2.4-6.5
<i>Enabling financing</i>				
Family monthly income (R\$)				
> 2500	1217	14.8	2.4	1.1-5.1
1501 - 2500	1382	20.1	2.0	1.2-3.2
501 - 1500	3556	51.8	4.1	2.9-5.7
≤ 500	931	13.2	15.2	6.8-30.5
<i>Need perceived</i>				
Perceived dental treatment				
No	1529	21.6	7.1	3.8-12.7
Yes	5623	78.4	4.0	2.7-6.1
<i>Need evaluated</i>				
Decayed teeth				
No	2818	42.9	4.7	2.4-9.0
One or more	4306	57.1	4.7	3.3-6.6

Table 2. Nonadjusted association of contextual and individual variables with non-utilization of dental services using multilevel logistic regression (SBBrasil 2010).

Variables	Variance† [VPC]‡	β	SE	OR	95% CI	P
<i>Null model</i>	1.485 (0.478)** [0.31]					
<i>Contextuals</i>						
<i>Predisposing demographic</i>						
HDI Longevity (2000)	1.166 (0.387)** [0.26]					
Low				1		
Moderate		0.094	0.550	1.10	0.37-3.23	0.864
High		-1.211	0.544	0.30*	0.10-0.87	0.026
<i>Predisposing social</i>						
HDI Education (2000)	1.328 (0.436)** [0.29]					
Low				1		
Moderate		-0.266	0.573	0.77	0.25-2.36	0.643
High		-0.867	0.560	0.42	0.14-1.26	0.121
Gini Index (2000)	1.371 (0.451)** [0.29]					
Low				1		
Moderate		-225	0.583	0.80	0.26-2.50	0.699
High		0.474	0.581	1.61	0.52-5.02	0.414
<i>Enabling health policies</i>						
OHT/FHS	1.360 (0.442)** [0.29]					
Low				1		
Moderate		-0.688	0.582	0.50	0.16-1.57	0.237
High		0.113	0.573	1.12	0.36-3.44	0.843
<i>Enabling financing</i>						
HDI Income (2000)	1.203 (0.400)** [0.28]					
Low				1		
Moderate		-0.518	0.527	0.60	0.21-1.68	0.326
High		-1.232	0.561	0.29*	0.10-0.88	0.028
<i>Individuals</i>						
<i>Predisposing demographic</i>						
Age						
35 - 39				1		
≥ 40		0.127	0.103	1.14	0.93-1.39	0.220
Sex						
Male				1		
Female		-0.341	0.106	0.71	0.58-0.88	0.001
<i>Predisposing social</i>						
Skin color						
White				1		
Yellow		-0.378	0.481	0.69	0.27-1.76	0.433
Indigenous		-0.959	1.029	0.38	0.05-2.88	0.352
Brown		-0.579	0.123	0.56	0.44-0.71	< 0.001
Black		0.330	0.156	1.39	1.03-1.89	0.034
Years of schooling						
≥ 12				1		
9 - 11		0.242	0.153	1.27	0.94-1.72	0.113
5 - 8		0.705	0.151	2.02	1.51-2.72	< 0.001
0 - 4		0.784	0.177	2.19	1.55-3.10	< 0.001
<i>Enabling financing</i>						
Family monthly income (R\$)						

> 2500			1		
1501 - 2500	0.517	0.230	1.68	1.07-2.63	0.025
501 - 1500	0.955	0.198	2.60	1.76-3.83	< 0.001
≤500	1.683	0.217	5.38	3.52-8.24	< 0.001
<i>Need perceived</i>					
Perceived dental treatment					
No			1		
Yes	-0.707	0.114	0.49	0.40-0.62	< 0.001
<i>Need evaluated</i>					
Decayed teeth					
No			1		
One or more	0.198	0.112	1.22	0.98-1.52	0.078

\* $P < 0.05$

\*\*  $P < 0.001$

† Variance at city level ( $\Omega\mu$ [standard error]) obtained through random effects

‡ Variance Partitioning Coefficient (VPC)

Table 3. Adjusted association of contextual enabling (HDI Income) and individual variables with non-utilization of dental services using multilevel logistic regression (SBBrasil 2010).

Variables	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
<b>Contextual</b>				
<i>Enabling financing</i>				
HDI Income (2000)				
Low	1	1	1	1
Moderate	0.60 (0.21-1.68)	0.54 (0.19-1.52)	0.59 (0.20-1.76)	0.57 (0.18-1.76)
High	0.29 (0.10-0.88)*	0.25 (0.08-0.75)*	0.31 (0.10-0.96)*	0.33 (0.10-0.97)*
<b>Individuals</b>				
<i>Predisposing demographic</i>				
<b>Sex</b>				
Male		1	1	1
Female		0.74 (0.60-0.92)*	0.70 (0.56-0.87)*	0.68 (0.54-0.84)*
<i>Predisposing social</i>				
<b>Skin color</b>				
White		1	1	1
Yellow		0.69 (0.27-1.80)	0.67 (0.26-1.76)	0.78 (0.30-2.05)
Indigenous		0.35 (0.05-2.61)	0.31 (0.04-2.37)	0.39 (0.05-2.98)
Brown		0.51 (0.39-0.65)**	0.50 (0.39-0.65)**	0.56 (0.43-0.72)**
Black		1.21 (0.89-1.65)	1.13 (0.82-1.55)	1.17 (0.84-1.62)
<b>Years of schooling</b>				
≥ 12		1	1	1
9 - 11		1.33 (0.98-1.80)	1.05 (0.76-1.45)	1.08 (0.77-1.51)
5 - 8		2.19 (1.61-2.95)**	1.49 (1.07-2.08)*	1.58 (1.12-2.23)*
0 - 4		2.36 (1.66-3.37)**	1.47 (1.01-2.17)*	1.58 (1.06-2.37)*
<i>Enabling financing</i>				
<b>Family monthly income (R\$)</b>				
> 2500			1	1
1501 - 2500			1.55 (0.97-2.46)	1.59 (0.98-2.56)
501 - 1500			2.31 (1.52-3.52)**	2.40 (1.55-3.73)**
≤500			4.59 (2.87-7.33)**	4.94 (3.03-8.04)**
<i>Need perceived</i>				
<b>Perceived dental treatment</b>				
No				1
Yes				0.43 (0.33-0.56)**
<i>Need evaluated</i>				
<b>Decayed teeth</b>				
No				1
One or more				1.36 (1.06-1.75)**
Variance at city level	1.203 (0.400)**	1.221 (0.405)**	1.350 (0.456)**	1.440 (0.485)**
( $\Omega\mu$ [standard error])† [VPC]‡	[0.28]	[0.27]	[0.29]	[0.30]

\*p < 0.05

\*\* p < 0.01

† Variance at city level ( $\Omega\mu$ [standard error]) obtained through random effects

‡ Variance Partitioning Coefficient (VPC)

Table 4. Adjusted association of contextual predisposing (HDI Longevity) and individual predictors with non-utilization of dental services using multilevel logistic regression (SBBrasil 2010).

Variables	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
<b>Contextual</b>				
<i>Predisposing demographic</i>				
HDI Longevity (2000)				
Low	1	1	1	1
Moderate	1.10 (0.37-3.23)	1.06 (0.36-3.14)	1.12 (0.36-3.44)	1.19 (0.37-3.79)
High	0.30 (0.10-0.87)*	0.25 (0.09-0.75)*	0.28 (0.09-0.86)*	0.30 (0.10-0.95)*
<b>Individuals</b>				
<i>Predisposing demographic</i>				
<b>Sex</b>				
Male		1	1	1
Female		0.74 (0.60-0.92)*	0.70 (0.56-0.87)*	0.68 (0.54-0.84)*
<i>Predisposing social</i>				
<b>Skin color</b>				
White		1	1	1
Yellow		0.69 (0.26-1.79)	0.67 (0.26-1.75)	0.77 (0.29-2.03)
Indigenous		0.35 (0.05-2.60)	0.31 (0.04-2.36)	0.38 (0.05-2.95)
Brown		0.51 (0.39-0.65)**	0.50 (0.39-0.64)**	0.56 (0.43-0.72)**
Black		1.21 (0.88-1.65)	1.12 (0.82-1.55)	1.16 (0.84-1.61)
<b>Years of schooling</b>				
≥ 12		1	1	1
9 - 11		1.33 (0.98-1.80)	1.05 (0.76-1.45)	1.08 (0.77-1.51)
5 - 8		2.18 (1.31-2.95)**	1.49 (1.07-2.08)*	1.57 (1.12-2.22)*
0 - 4		2.36 (1.65-3.36)**	1.47 (1.00-2.17)	1.58 (1.06-2.36)*
<i>Enabling financing</i>				
<b>Family monthly income (R\$)</b>				
> 2500			1	1
1501 - 2500			1.55 (0.97-2.46)	1.59 (0.98-2.56)
501 - 1500			2.31 (1.52-3.52)**	2.40 (1.55-3.72)**
≤ 500			4.59 (2.87-7.34)**	4.94 (3.04-8.04)**
<i>Need perceived</i>				
<b>Perceived dental treatment</b>				
No				1
Yes				0.43 (0.33-0.56)**
<i>Need evaluated</i>				
<b>Decayed</b>				
No				1
One or more				1.37 (1.06-1.76)**
Variance at city level ( $\Omega\mu$ [standard error])† [VPC]‡	1.166 (0.387)** [0.26]	1.187 (0.392)** [0.27]	1.267 (0.428)** [0.28]	1.348 (0.454)** [0.29]

\*p < 0.05

\*\* p < 0.01

† Variance at city level ( $\Omega\mu$ [standard error]) obtained through random effects.

‡ Variance Partitioning Coefficient (VPC)



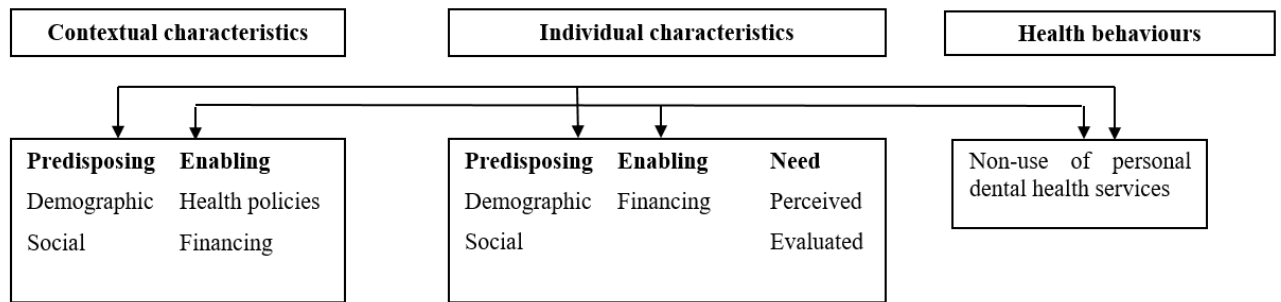


Figure 1. Theoretical model adapted from the Andersen's behavior model of dental health services including contextual and individual characteristics (20).