

## Desire for tooth bleaching and treatment performed in Brazilian adults: findings from a birth cohort

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**Abstract:** Population-based studies estimating the prevalence of tooth bleaching desire or the percentage of individuals who had performed this treatment are rare. Thus, the aim of this study was to evaluate the desire to perform tooth bleaching and the prevalence of adult individuals who had performed the treatment and investigate the association of these outcomes. A subsample (n = 536) of the 1982 Pelotas birth cohort in southern Brazil was investigated at the ages 15, 24 and 31 by clinical examinations and interviews. The prevalence of bleaching at 31 years was 15.6% [95%CI 12.6–18.9] while 85.9% [95%CI 82.7–88.7] reported they desired the treatment. Multivariate Poisson regression analysis showed that individuals who have visited the dentist within the last year showed a treatment prevalence ratio (PR) 2.31 times [95%CI 1.40–3.83] higher compared with those who had the last dental visit more than a year before the interview. Similarly, individuals with smoking habits presented an elevated PR of 1.60 [95%CI 1.00–2.55], and the low-income trajectory group showed the largest PR of desire for tooth bleaching (1.17 [95%CI 1.07–1.28]). Moreover, individuals from the high-risk caries trajectory group presented a higher prevalence of desire for tooth bleaching than individuals from low caries trajectory group. Individuals who have declared being “dissatisfied” with their dental color presented a prevalence of desire for tooth bleaching 16% greater than “satisfied” ones. Thus, the present findings confirm that tooth bleaching has become a frequently desired dental treatment to improve dental aesthetics in the population and a considerable rate of adults has performed the treatment.

**Keywords:** Tooth Bleaching; Epidemiology; Esthetics, Dental.

### Introduction

Dental discoloration is a prevalent condition affecting different age groups that can be induced by diseases or by the natural process of dental senescence.<sup>1,2</sup> Despite not being a disease that directly compromises the health of individuals, the presence of tooth darkening can influence relationships and induce a negative self-image.<sup>3,4</sup> Besides, bleaching has been reported to lead to psychological influences<sup>5</sup> and improve oral health related quality of life in patients who underwent at-home vital bleaching.<sup>6</sup>



Esthetic concepts are increasing in the present society resulting in a growing demand for esthetic procedures.<sup>7,8</sup> Patients are not only willing to present a well-aligned smile, but also requesting whiter teeth, thus dental bleaching treatments have become more popular.<sup>9</sup> Different methods of dental bleaching are available for patients and clinicians, including over-the-counter products, at-home products used under the supervision of the dentist, and in-office products, with most containing different concentrations of hydrogen or carbamide peroxide.<sup>10</sup> Generally, except for some over-the-counter (OTC) products, bleaching agents are effective, improving tooth color with few side effects, especially considering at-home treatments for vital teeth with low agent concentration.<sup>9,11,12</sup>

The advertised results associated with the growing demand for esthetics induce patients to desire dental bleaching and leading dentists to be more prone to offer and perform the treatment.<sup>13,14,15</sup> However, the influence of socioeconomic and environmental factors on both the desire and the accomplishment of dental bleaching is unknown. The economic and social condition influence the recommendation and option for treatments<sup>16,17</sup> and can be a decisive component in the choice and desire for dental bleaching. In addition, people with habits that can pigment the teeth like smoking could be more likely to perform whitening, since their teeth may become darker with the continuity of the habit, contributing thus to an elevated prevalence of bleaching.

Despite studies suggesting that tooth bleaching is a treatment commonly desired by patients, there is only one population-based study estimating the prevalence of tooth bleaching desire<sup>18</sup> and no study investigating the percentage of individuals who had performed these treatments at a population level. Also, it would be interesting to determine the factors that account for dental bleaching treatment. Therefore, the aim of the present study was to evaluate the desire to perform tooth bleaching and the prevalence of adult individuals who had performed the treatment in a birth cohort. The association of these outcomes with demographic, socioeconomic, behavioral, oral health and aesthetic perception variables was also investigated.

## Methodology

This study followed the STROBE statement (Strengthening the Reporting of Observational Studies in Epidemiology). Pelotas is a medium sized city, located in southern Brazil, near the border with Uruguay. In 1982, all the infants born at three maternity hospitals in the city were identified. The 5,914 liveborn infants were measured and their mothers were interviewed at birth and at several follow-ups; detailed information about the methods of this cohort study is available elsewhere.<sup>19,20</sup>

In 1997, a representative sample of the cohort's 900 adolescents was selected to take part in the first Oral Health Study (OHS-97), which consisted of dental examinations and an interview. The 888 adolescents were contacted again in 2006 for another oral health study (OHS-06), of which 720 individuals were found. In 2013, when the participants were 31 years old, a new oral health study was performed (OHS-13). The 888 individuals that have participated in the first OHS were contacted. This study consisted of an oral examination and an interview, including oral health habits and self-perception of oral conditions.

### Outcome variables

For this study, two outcomes were used: a) performed tooth bleaching treatments; b) desire to undergo tooth bleaching. The information was obtained using two questions: "Have you already performed a bleaching treatment to whiter your teeth?" and "Would you wish to perform a treatment to white your teeth?". Both outcomes were collected in a dichotomous manner (yes/no).

### Independent variables

Independent variables were collected in different assessments of the Oral Health Studies. The group-based trajectory modelling was utilized to identify the groups of individuals with similar trajectory of income measured in four time points (at birth, OHS-97, OHS-06 and OHS-13). Individuals were asked about their income, which was collected in a continuous variable in Brazilian reals (BRL) and categorized in tertiles. Thus, the models were estimated with the command "traj" in the Stata 12.0<sup>21</sup> to identify the similarity of income

trajectory between the individuals. The parameters for the trajectory model were determined based on the maximum likelihood of the Newton method.<sup>22,23</sup> The selection of the model considered the estimate for latent number of categories and the order of polynomial for each latent trajectory. The number of trajectories was determined when the sequential comparisons of the Bayesian information criterion (BIC) and their adjusted criterion between the model with  $K$  and  $K+1$  trajectories yielded no further substantial difference in the BIC score than the  $k + 1$  model. Thus, the BIC for income trajectory supported three trajectory groups (high, downward and low trajectory). Trajectory for caries was performed similarly. The D component of the DMFT (decayed, missing, and filled teeth) index was collected in three points (OHS-97, OHS-06 and OHS-13) and considered to estimate caries trajectory. The analysis of caries variables supported a model with two groups of trajectory, being nominated as “high” and “low” caries risk.

Other independent variables that were used in this study were collected in OHS-13. Time since last dental visit was collected in years and dichotomized in “up to 1 year” and “more than 1 year”. Type of service where individuals had the last dental visit was also collected and categorized in public, private health insurance, and out-of-pocket.

Smoking habit was also collected at age 30. Individuals who have declared smoking at least one cigarette per week were classified as “smokers”. “Self-perception about dental appearance and teeth color was collected in a 5 grade Likert scale by the questions: “Considering the appearance of your teeth, are you...” and “Considering the color of your teeth, are you...” and dichotomized in “Satisfied” (very satisfied, satisfied, neither satisfied nor dissatisfied) and “dissatisfied” (dissatisfied and very dissatisfied).

The fieldwork team comprised six dentists and interviewers that were trained for questionnaire application. Questionnaire was pre-tested before the start of the study in order to evaluate the comprehension of the instrument in a sample of 20 adults from different socioeconomic status. During the study, 10% of the sample was re-interviewed with a short version of the questionnaire for quality control. The fieldwork was carried out between October 2013 and January 2014.

Losses were considered when the contact (by phone and e-mail) with cohort members was not possible and the individual was not found after three visits in different periods of the day in their household.

## Data analysis

Data were entered in an electronic spreadsheet and analyzed using the software Stata 12.0. Descriptive analysis was performed to assess the prevalence of the outcomes. The association of outcomes with independent variables was evaluated in bivariate way by chi-square test. Multivariate Poisson regression models have been proposed to estimate prevalence ratios of binary outcomes in cross-sectional studies. In the present study, Poisson Regression was used to assess the association of both outcomes with exposure variables, adjusting by possible confounders.<sup>24</sup> The entrance of variables on the model was determined by a theoretical hierarchical model described in Figure. Socioeconomic and demographic variables were placed on more distal positions, followed by behavioral characteristics. Self-perception of individuals’ dental color and appearance were positioned in the most proximal block. Each variable was adjusted for variables from the same and upper blocks of the model. Prevalence ratios and 95% confidence intervals were estimated from the models.

## Ethical issues

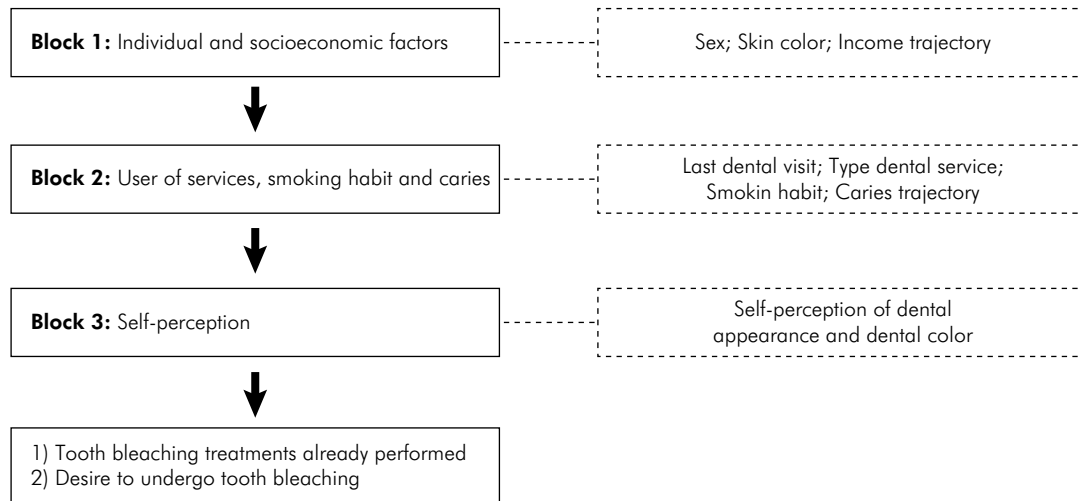
This project was approved by the UFPel Ethics Committee. All the examinations and interviews were performed with individual authorization after participants signed informed consent forms. Individuals who had treatment needs were identified and referred for treatment.

## Results

A total of 536 individuals answered the questionnaire in 2013, representing a 60.4% response rate compared to the first study of oral health conducted in 1997. The number of refusals represented nearly 5% of the original sample while losses totalized 34%. Individuals wishing to undergo tooth bleaching were 85.9% (95% CI: 82.7–88.7), while 15.6% (12.6–18.9) had underwent bleaching treatment.

In the bivariate analysis of factors associated with the outcomes (Table 1), an association of time since the last dental visit with carrying out bleaching was

observed. Individuals who had the last dental visit in the last 12 months presented a higher prevalence of having had bleaching treatment. Regarding the



**Figure.** Theoretical model for analysis of desiring and having performed dental bleaching and independent variables.

**Table 1.** Bivariate analysis of outcomes according to independent variables in adults from 1982 Pelotas birth cohort (n = 536).

Independent variables	Dental bleaching	p-value	Desire for dental bleaching	p-value
Sex				
Male	35 (13.0)	0.100	219 (83.6)	0.113
Female	48 (18.2)		222 (88.5)	
Income trajectory				
High	43 (19.2)	0.139	173 (79.7)	0.001
Downward	30 (13.1)		193 (89.4)	
Low	10 (12.6)		75 (93.6)	
Last dental visit				
More than 1 year	17 (7.3)	< 0.001	191 (88.4)	0.214
Up to 1 year	66 (22.8)		241 (84.6)	
Type of dental service				
Public	11 (9.2)	0.052	92 (91.1)	0.140
Private health insurance	16 (15.2)		91 (88.4)	
Out of pocket	56 (18.9)		247 (83.7)	
Caries trajectory				
Low	69 (17.1)	0.077	322 (83.4)	0.004
High	14 (10.7)		119 (93.7)	
Smoking habit at 30 years				
No	56 (14.3)	0.150	322 (85.9)	0.611
Yes	19 (20.2)		80 (87.9)	
Self-perception of dental appearance				
Satisfied	51 (14.3)	0.238	316 (83.6)	0.010
Dissatisfied	32 (18.9)		125 (92.6)	
Self-perception of dental color				
Satisfied	51 (14.3)	0.238	272 (80.7)	< 0.001
Dissatisfied	32 (18.2)		169 (96.0)	

desire to perform dental bleaching, individuals from the lowest income trajectory presented a higher desire similarly to those who presented a high risk caries trajectory. In addition, individuals dissatisfied with their teeth color and those with worse self-perception of dental appearance also presented a greater prevalence of desire to perform tooth bleaching.

Table 2 shows the results of crude and adjusted analyses for factors associated to having performed bleaching treatment. After adjustments, the time since

last dental visit, smoking habit and self-perception of tooth color were associated with this variable. Individuals who have visited the dentist within the last one year showed a 131% higher prevalence of treatment compared with those who carried out the last dental visit more than a year before the interview. In addition, individuals with smoking habits presented a 60% higher prevalence of having performed tooth bleaching compared with no smokers. Similarly, individuals who declared being “dissatisfied” with

**Table 2.** Crude (c) and adjusted (a) prevalence ratios (PR) for factors associated with tooth bleaching in individuals from 1982 Pelotas birth cohort (n = 536). Poisson regression analysis.

Independent variables	PR <sup>c</sup> (95% CI)	p-value	PR <sup>a</sup> (95% CI)	p-value
-2 log likelihood (Empty model) = 475.01816				
Block 1				
Sex				
Male	1		1	
Female	1.04 (0.93–2.09)	0.099	1.38 (0.89–2.14)	0.069
Income trajectory				
High	1		1	
Downward	0.68 (0.44–1.04)	0.141	0.66 (0.43–1.02)	0.106
Low	0.64 (0.33–1.21)		0.62 (0.32–1.18)	
-2 likelihood (Block 1) = 468.77846				
Block 2				
Last dental visit				
More than 1 year	1		1	
Up to 1 year	3.12 (1.88–5.18)	< 0.001	2.31 (1.40–3.83)	0.001
Type of dental service				
Public free	1		1	
Private health insurance	1.64 (0.80–3.39)	0.067	1.36 (0.72–2.55)	0.504
Out of pocket	2.03 (1.10–3.75)		1.36 (0.72–2.55)	
Caries trajectory				
Low	1		1	
High	0.62 (0.36–1.07)	0.087	0.76 (0.44–1.32)	0.330
Smoking habit at 30 years				
No	1		1	
Yes	1.41 (0.88–2.26)	0.144	1.60 (1.00–2.55)	0.050
-2 likelihood (Block 1 + Block 2) = 403.715				
Block 3				
Self-perception of dental appearance				
Satisfied	1		1	
Dissatisfied	0.79 (0.49–1.26)	0.324	0.77 (0.44–1.32)	0.339
Self-perception of dental color				
Satisfied	1		1	
Dissatisfied	1.27 (0.85–1.91)	0.236	1.63 (1.05–2.52)	0.030
-2 likelihood (Block 1 + Block 2 + Block 3) = 400.2285				

their teeth color presented a prevalence of having performed tooth-bleaching 63% higher than those who declared being satisfied with tooth color.

Table 3 shows the results of crude and adjusted analyzes for factors associated with the desire to perform dental bleaching. After adjustments, the final model showed that individuals from the low-income

trajectory group had a prevalence of desire for tooth bleaching 17% greater than those from the high-income trajectory group. Moreover, individuals from the high-risk caries trajectory group presented a higher prevalence of desire for tooth bleaching than individuals from the low caries trajectory group. Similarly, individuals who have declared being

**Table 3.** Crude (c) and adjusted (a) prevalence ratios (PR) for factors associated with desire for tooth bleaching in individuals from 1982 Pelotas birth cohort (n = 536). Poisson regression analysis.

Independent variables	PR <sup>c</sup> (95% CI)	p-value	PR <sup>a</sup> (95% CI)	p-value
-2 log likelihood (Empty model) = 1, 015.38572				
Block 1				
Sex				
Male	1	0.113	1	0.197
Female	1.06 (0.99–1.14)		1.05 (0.98–1.12)	
Income trajectory				
High	1	0.001	1	0.002
Downward	1.12 (1.03–1.22)		1.12 (1.03–1.21)	
Low	1.18 (1.08–1.28)		1.17 (1.07–1.28)	
-2 likelihood (Block 1) = 1,013.31846				
Block 2				
Last dental visit				
More than 1 year	1	0.206	1	0.382
Up to 1 year	0.96 (0.89–1.03)		0.97 (0.90–1.04)	
Type of dental service				
Public free	1	0.101	1	0.240
Private health insurance	0.92 (0.85–0.99)		1.04 (0.94–1.15)	
Out of pocket	0.97 (0.88–1.07)		0.97 (0.88–1.06)	
Caries trajectory				
Low	1	<0.001	1	0.014
High	1.12 (1.05–1.20)		1.09 (1.02–1.17)	
Smoking habit at 30 years				
No	1	0.594	1	0.979
Yes	1.02 (0.94–1.12)		1.00 (0.91–1.09)	
-2 likelihood (Block 1 + Block 2) = 894.24588				
Block 3				
Self-perception of dental appearance				
Satisfied	1	0.002	1	0.357
Dissatisfied	1.11 (1.04–1.18)		0.96 (0.87–1.05)	
Self-perception of dental color				
Satisfied	1	< 0.001	1	< 0.001
Dissatisfied	1.19 (1.12–1.26)		1.16 (1.07–1.25)	
-2 likelihood (Block 1 + Block 2 + Block 3) = 892.74292				

“dissatisfied” with their dental color presented a prevalence of desire for tooth bleaching 16% greater compared to satisfied individuals.

## Discussion

To the best of our knowledge, this is the first population-based study to investigate not only the prevalence of individuals who underwent tooth bleaching, but also the prevalence of the desire to perform this treatment. A high proportion (85%) of the surveyed adult population have the desire to perform tooth bleaching, while 15% had undergone bleaching treatment, which is in line with the increasing demand for esthetic dental treatments,<sup>9,13</sup> and their popularization.

The high prevalence of the desire to undergo tooth bleaching can be due to the high concern of the Brazilian population about not only dental esthetics, but also general esthetic appearance. Brazil is one of the countries with the highest number of performed plastic surgeries.<sup>25</sup> Concerns about general esthetics could obviously have an impact on dental esthetics, as the smile is an important component of individuals' appearance. The clinical effectiveness with low level of adverse effects of vital at-home bleaching is reported in several systematic reviews<sup>11,26,27</sup> The efficacy of in-office tooth bleaching and its relatively low cost compared to other treatment alternatives (composite or ceramic veneers) to recover the color in darkened teeth<sup>11,26,27</sup> are other reasons for the popularity of bleaching among patients.<sup>6,9,10</sup> These findings corroborate with previous studies reporting a high prevalence of the desire to perform bleaching in adult populations.<sup>10,12</sup>

Desire for tooth bleaching was greater in individuals from downward and low income trajectory group. This might have been found because dental bleaching could increase the esthetic perception with a positive psychosocial impact and improve the quality of life.<sup>5,6</sup> Thus, individuals with a low income trajectory can perceive dental whitening as a way to compensate for social deprivations and improve their esthetic perceptions as an approach to minimize their unfavorable social condition. White smiles are linked with physical attractiveness resulting in greater feeling

of happiness,<sup>28</sup> explaining the high desire of these individuals for dental bleaching even when presenting unfavorable oral health conditions. On the other hand, it is likely that individuals with low socioeconomic status have less access to aesthetic treatments, increasing their desire to perform it. Although a tendency for a lower prevalence of having undergone tooth whitening was observed in lower socioeconomic groups, this association was not significant.

A higher desire for dental bleaching was observed also in individuals with high caries trajectory. It is important to highlight that to perform caries trajectory analysis only the decayed component of DMFT was used. Therefore, the participants classified as high risk for caries presented with decayed teeth in all three time points assessed. The elevate desire for dental bleaching in these individuals can reflect an unconscious aspiration to search for access to oral health services or perhaps a false sense of having the possibility to improve their oral health. Individuals with worse social conditions have less access to the health services<sup>29,30,31</sup> even when presenting poor dental health.<sup>32,33</sup> In addition, these individuals generally have a misknowledge about the dark discoloration that cavities might present and the appropriate treatment. Thus, some people might believe that performing tooth bleaching would improve their oral health and increase attractiveness.<sup>5</sup>

A higher prevalence of dental bleaching was found in individuals who declared to have visited the dentist less than one year before the interview. This might have been found because of dentists offering this type of treatment, even for patients that have no complaints about tooth color. In fact, the dentist suggestion for treatments can induce the patient to perform them. However, the type of service was not associated with this outcome, which indicates that seeing a dentist regularly can be a decisive factor for performing tooth bleaching, regardless of type of service used. Visiting the dentist at least once a year could indicate a greater concern about oral health and esthetics,<sup>34</sup> even in those who access public dental services, where professional tooth bleaching is not offered. Frequent dental visits could promote a greater knowledge about treatments and consequently motivate the search for alternatives,

which can vary from professional tooth bleaching to treatments with OTC products.

It is known that many factors can cause teeth pigmentation, such as strongly colored foods and drinks, and smoking. Previous studies showed that smokers present a higher dissatisfaction with tooth color, which compromises dental esthetics.<sup>3,35</sup> In the present study, a 60% higher prevalence of having undergone tooth bleaching was found in individuals with smoking habits at 30 years. This could be because greater dental pigmentations are observed in smokers. A recent clinical trial evaluated at-home dental whitening in smokers and non-smokers and found differences between groups only before performing clinical dental prophylaxis.<sup>36</sup> After prophylaxis, teeth color did not presented significant differences. Thus, even if these pigmentations are extrinsic, they cause a significant change on the perception of tooth coloration, which can lead individuals to search for dental bleaching to increase their satisfaction with tooth color.

Among subjective measures of self-perception, tooth color perception was the only one associated with the desire for bleaching treatment. Individuals who reported being dissatisfied with the color of their teeth showed a higher desire of perform dental bleaching. Moreover, they also performed more dental whitening, proving that the main reason that motivates people to search for bleaching treatment is the perception of dark teeth, as suggested by other authors.<sup>3</sup> This probably occurred because these individuals are more worried about their teeth color, and consequently are trying to look for alternatives to improve their appearance.

Important points should be highlight about the present study. The population-based sample confers external validity to our findings. Furthermore, young

adults are the potential target of dental bleaching, due to the demand for esthetics in this population. Therefore, studies including elders can underestimate the results since the requirements in relation to esthetics are lower in this age group.<sup>7</sup> Also, a multidisciplinary cohort design allows collecting behavioral and socioeconomic variables with precision, such as smoking habits and socioeconomic status in several moments of the life course. On the other hand, some limitation should be highlighted. Using a questionnaire to assess the outcomes could lead to an overestimation of the results, especially regarding prevalence of treatment, since individuals could interpret tooth bleaching as any method to white their teeth, including those considered ineffective, such as the use of dentifrices.<sup>37</sup>

Another point to consider is that individuals who have never considered dental bleaching could answer “yes” to the question of desire for treatment when this option is offered to them, producing an overestimated result. However, this outcome was evaluated similarly in other studies.<sup>4,38</sup>

## Conclusion

The present findings confirm that tooth bleaching has become a frequently desired dental treatment to improve dental esthetics and a considerable proportion of adults has performed the treatment. Our results suggest that variables related to regular visits at the dentist, smoking habit and self-perception with dental color, act as a major factors for wishing or having performed dental bleaching. In addition, income and caries trajectories were strongly associated with desire to perform dental bleaching, showing that experiences in the life course influence oral health outcomes.

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