Original Article

Methods for caries prevention in adults among dentists from a brazilian community

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Little is known about dental practice patterns of caries prevention in adults among Brazilian dentists. **Aim:** To quantify procedures used for caries prevention for adult patients among dentists from a Brazilian community. **Methods:** Dentists (n=197) who reported that at least 10% of their patients are more than 18 years old participated in the first Brazilian study that used a translated version of the "Assessment of Caries Diagnosis and Caries Treatment" from the U.S. National Dental Practice-Based Research Network. A questionnaire about characteristics of their practice and patient population were also completed by the dentists. Generalized linear regression models and a hierarchal clustering procedure were used (p<0.05). **Results:** In-office fluoride application was the preventive method most often reported. The main predictors for recommending some preventive agent were: female dentist (dental sealant; in-office fluoride; non-prescription fluoride) and percentage of patients interested in caries prevention (dental sealant; in-office fluoride; non-prescription fluoride). Other predictors included private practice (dental sealant), percentage of patients 65 years or older (in-office fluoride), graduation from a private dental school (non-prescription fluoride), years since dental school graduation (chlorhexidine rinse) and using a preventive method (recommending sealant/fluoride/chlorhexidine rinse/sugarless, xylitol gum). Cluster analysis showed that dentists in the largest subgroup seldom used any of the preventive agents. **Conclusion:** Dentists most often reported in-office fluoride as a method for caries prevention in adults. Some practitioner, practice and patients' characteristics were positively associated with more-frequent use of a preventive agent.

Keywords: Dental caries. Practice Patterns, Physicians. Preventive dentistry.

Introduction

Caries prevalence in adults is high worldwide. More than 90% of adults experience caries at some point in their lifetimes[1-4]. Mean DMFT scores for 35- to 44-year-old adults ranged from 6.6 to 17.6 among twenty-three European countries[3] and is 16.75 among Brazilian adults, according to the last national epidemiological survey[1].

A recent report estimated that about 25 percent of adults in the U.S. had untreated caries[5]. Treatment needs were reported by 75% and 47% of Brazilian adults and elderly, respectively[1]. These findings may be related to the fact that dental caries prevention efforts historically have focused on children rather than adults[6]. A major increase in the focus of public health efforts in adults should be on those who are transitioning into higher caries risk status[7].

Therefore, dentists and dental health managers should direct efforts to improve adults' oral health and research should assess the oral health status as well as which preventive strategies the adult population is receiving from their dentists.

Members of the Dental Practice-Based Research Network (Dental PBRN) from the United States, Denmark, Norway, and Sweden reported applying in-office fluoride on 37% of their adult patients[8]. A minority (21%) of dentists in the Japan Dental PBRN recommended in-office fluoride application to most of their patients over 18 years old[9]. The most-frequent users of caries prevention were recently-graduated dentists, those who perform caries risk assessment or who practice individualized caries prevention[8]. Japanese dentists whose patients are interested in caries prevention or those who believe in the effectiveness of caries risk assessment were more likely to recommend in-office fluoride to 50% or more of their patients[9].

Dentists from the Brazilian community of Araraquara, São Paulo State, participated in the first Brazilian study to use the same questionnaire (after translation and cultural adaptation) used in the U.S. and Japanese studies described above to assess dental preventive practices. The current study aims to quantify procedures used for caries prevention for adult patients among these Brazilian dentists.

MATERIAL AND METHODS

Study design

This research is part of a major cross-sectional study that was performed to assess dental practices related to diagnosis and treatment of dental caries by means of two paper questionnaires: (1) one about characteristics of their practice and patient population; and (2) a translated version of the "Assessment of Caries Diagnosis and Caries Treatment" from the U.S National Dental Practice-Based Research Network. In the present paper, we present the results from the caries prevention section of the questionnaire.

Ethical aspects

The major cross-sectional study was reviewed and approved by the Institutional Review Board (Research Ethics Committee; protocol number #78/11). All participants provided informed consent prior to participation in the study.

Participants and Data Collection

Questionnaires were sent by mail to 801 dentists for whom we had address/contact information. During study planning, we received a list of 722 dentists registered at the Regional Council of Dentistry of São Paulo State – Araraquara region, in 2011. Because data were collected in 2014-2015, we updated the list by consulting internet sources, which increased the list to 801 dentists. After using several strategies to increase the response rate (pre-paid return envelope, questionnaires sent to work address; a second copy of the questionnaire to non-respondents; precontact by telephone; collection of completed questionnaires at work address)[10], a total of 217 dentists who met all inclusion criteria (currently practices in Araraquara, treats dental caries; not retired; and provided signed informed consent) participated in the major study, providing an overall response rate of 27% (217/801). In the present paper, participants were 197 dentists among the 217 dentists who reported that at least 10% of their patients are more than 18 years of age.

Measures

Participant dentists received two paper questionnaires: (1) one about demographic data and information about their clinical training and individual practices and (2) a translated version of the "Assessment of Caries Diagnosis and Caries Treatment" from the U.S National Dental Practice-Based Research Network. The Brazilian version of the questionnaire was produced by conducting the following steps: initial translation, back-translation, committee review[11] and pre-testing, during which comprehension of questions was tested with 21 dentists and test-retest reliability was estimated with 17 dentists, with a mean time between test and retest of seven days. Results from this process showed the Intraclass Correlation Coefficients (ICC) as follows: 22 (42%) questions with satisfactory correlation (0.40≤ICC<0.75) and 31 (58%) with excellent correlation (ICC≥0.75), according to Szklo and Nieto[12] (2000). Considering that the translated questionnaire does not measure psychometric data and had been previously validated[13], no additional validation was needed. Detailed information on the process is published elsewhere[10].

Table 1 presents the series of questions asked about the use of caries preventive agents in adult patients as well as questions about caries diagnosis, caries risk assessment, and individualized caries preventive treatment regimen.

Statistical analyses

Descriptive statistics were calculated for all study variables. When reporting ordinal variables representing the percentage of patients receiving caries-related procedures and prevention, ordinal responses are presented as the 25Th, 50th (median) and 75th percentile. In addition, these ordinal data were transformed to the average of each end-point for each category as follows: 0%=0%, 1-24%=12.5%, 25-49%=37%, 50-74%=62%, 75-99%=87%, 100%=100%. The distance between ordinal categories, although not equal, can be estimated in this way with moderate precision. Consequently, we believe the data transformed to percentages in this manner for presentation in the tables can aid readers in interpretation.

Table 1. Questions asked about caries prevention, assessment, caries risk assessment, and individualized preventive treatment.

Instructions: Of patients more than 18 years old, for what percentage do you:
Caries prevention
Apply dental sealants on the occlusal surface of at least one of their permanent teeth?
Administer an in-office fluoride application, such as fluoride gel, fluoride varnish, or fluoride rinse?
Recommend a non-prescription (over-the-counter) fluoride rinse?
Provide a prescription for some form of fluoride?
Recommend an at-home regimen of Chlorhexidine rinse?
Recommend sugarless chewing gum or xylitol chewing gum?
Caries assessment, risk assessment, individualized preventive treatment
When you examine patients to determine if they have a primary occlusal caries lesion, on what percent of these patients do you use a dental explorer to diagnose the lesion?
Do you assess caries risk for individual patients in any way?
Do you use a special form for caries risk assessment?
What percent of patients in your practice are interested enough in caries prevention to justify you recommending to them an individualized caries preventive regimen?
For what percent of patients do you give individualized preventive treatment specifically for their needs?
Participants had the following answering choices:
1 – Never or 0%
2 – 1 to 24%
3 – 25 to 49%
4 – 50 to 74%
5 – 75 to 99%
6 – Every time or 100%

Next, practitioner and practice characteristics were tested as predictors of use for each caries prevention agent for adult patients using generalized linear models and an ordinal response model. These variables included dentist gender (male=0 and female=1), years since dental school graduation, whether the dental school from which the dentist graduated was private or public (public=0 and private=1), completed specialization training (general dentistry=0 and specialization=1), an advanced degree (no advanced degree=0, master's or doctorate=1), percentage of patients who are 65 years of age or older, the dentist's practice is exclusively a private practice model (public health or hybrid private/public health models=0, private=1). Practitioner and practice characteristics that were significant at p<0.10 were included in the first step of subsequent model testing for each individual caries prevention agent. Next, these items were included in a second step: caries-related practice patterns; percent of patients for whom a dental explorer is used to diagnose an occlusal caries lesion; whether caries risk was assessed (not performing caries risk assessment=0 and performing caries risk assessment=1); and percentage of patients who desire individualized caries prevention and who receive an individualized caries prevention regimen. In the final step, frequencies of the other preventive agents were entered to test for associations between use of agents. A backward elimination approach was used for step two and three that removed the least-significant variable from the model in subsequent steps until all remaining variables were significant using p<0.10 for retention[14]. The change in the chi-square (x^2) statistic as well as the differences in degrees of freedom ($x^2_{diff} = x^2_s - x^2_1$ and $df_{diff} = df_s - df_1$ where s denotes the "smaller" model with less parameters) were used to test for significance and reflects the improvement in prediction following each step[15].

To identify subgroups of dentists with a similar preventive orientation, a hierarchal clustering procedure was used. The sugarless or xylitol gum variable was not included as it was

considered an adjunctive rather than a primary prevention agent. Ward's clustering method with squared Euclidean distances as the similarity measure was chosen in order to be sensitive to differences in elevation as well as profile shape[16]. Dentist and practice characteristics were tested for differences across the preventive clusters using ANOVA or chi-square as appropriate. Pair-wise comparisons were performed using a Bonferroni correction.

RESULTS

Table 2 shows the practitioner and practice characteristics for eligible dentists. Most of them were females (59%), working in a private hybrid (private + public) model (78%), graduated from a public institution (77%), and had received specialty training (63%).

Table 3 summarizes the frequency of use of each caries prevention agent for adult patients. In-office fluoride application was the preventive method most reported by dentists for caries prevention in adults.

Table 4 shows results of the generalized linear regression modeling, specifically the statistical significance at each step in the analysis and the parameter estimates for the predictors of the frequency of use of each caries prevention agent.

Dental sealants. Female dentists and those in private practice apply dental sealants to a higher percentage of adult patients compared to dentists in other practice models (p=0.001) and male dentists (p=0.044). In step 2, dentists who have a greater percentage of patients interested in a caries prevention regimen apply dental sealants to a significantly higher percentage of adult patients (p=0.048). In step 3, dentists who apply dental sealants to a higher percentage of adult patients are also more likely to administer an in-office fluoride (p=0.042) and recommend sugarless/xylitol gum (p=0.012) more often to their adult patients. The overall model was a good fit for the data [x^2 (5) = 21.645, p=0.001].

In-office fluoride. Female dentists administer an in-office fluoride application to a higher percentage of adult patients compared to male dentists (p=0.014). In addition, dentists with a higher percentage of patients who are 65 years of age or older were more likely to use in-office fluoride (p=0.042). In step 2, dentists who have a greater percentage of patients interested in a caries prevention regimen are more likely to administer an in-office fluoride to their adult patients (p=0.009). In step 3, dentists who more frequently administer an in-office fluoride to their adult patients are also more likely to apply dental sealants (p=0.006) and recommend a non-prescription fluoride (p=0.001). The overall model was a good fit for the data [x^2 (6) = 26.972, p<0.001].

Non-prescription fluoride. Female dentists recommend an over-the-counter (OTC) fluoride rinse to a higher percentage of adult patients compared to male dentists (p=0.009). Dentists who graduated from a private dental school recommend an OTC fluoride rinse to a larger percentage of their adult patients than dentists who graduated from a public dental school (p=0.017). In step 2, dentists who have a greater percentage of patients interested in a caries prevention regimen (p=0.012) are more likely to administer an OTC fluoride to their adult patients compared to dentists who have a smaller percentage of patients interested in a caries prevention regimen. In step 3, dentists who are more likely to recommend an OTC fluoride rinse are significantly more likely to apply in in-office fluoride (p<0.001) and recommend an at-home regimen of chlorhexidine rinse (p<0.001). The overall model was a good fit for the data [x^2 (6) = 35.518, p<0.001].

Prescription fluoride. In step 3, dentists who more frequently provide a prescription for some form of fluoride are significantly more likely to apply in in-office fluoride (p=0.042) and recommend an at-home regimen of chlorhexidine rinse (p=0.012). The overall model was a good fit for the data [x^2 (2) = 9.484, p=0.009].

Table 2. Dentist's and practice's characteristics

Characteristic	Percentage (n) Mean (SD) Mean % [Δ], Percentiles (25th, 50th, 75th) [Φ]
Age of dentist	42.2 (SD=11.4)
Gender of dentist (female)	59% (n=116)
Type of practice	
Private practice	50% (n=98)
Private/public hybrid	28% (n=55)
Public health	17% (n=34)
Other	5% (n=10)
Years since dental school graduation	19.7 (SD=11.1)
Type of dental school from which the dentist graduated	
Public institution	77% (n=151)
Private institution	23% (n=46)
Specialization	
Not completed specialization training	37% (n=72)
Specialization training	63% (n=125)
Advanced degree	
No advanced degree	70% (n=138)
Master's degree	6% (n=11)
PhD degree	25% (n=48)
Percent of patients by age cohort	
Pediatric patients (1-18 years)	19% (SD=19)
Adults (19-44 years)	36% (SD=17)
Adults (45-64 years)	32% (SD=16)
Adults (65 years or older)	13% (SD=10)
Percent of patients a dental explorer is used to diagnose an occlusal caries lesion?	65% 2, 5, 6
Assess caries risk for individual patients	34% (n=63) [¥]
Use a special form for caries risk assessment (of the 63 who perform caries risk assessment)	38% (n=24)
Percent of patients who are interested in a caries prevention regimen	44% 2, 4, 4
Percent of patients who receive a caries risk prevention regimen	54% 2, 4, 5

[Δ] Percentage when the ordinal values were transformed as follows to category median: 0%=0%, 1-24%=12.5%, 25-49%=37%, 50-74%=62%, 75-99%=87%, 100%=100%
[Φ] 25Th, 50th (median) and 75th percentile for ordinal categories scaled as 1 − Never or 0%, 2 − 1 to 24%, 3 − 25 to 49%, 4 − 50 to 74%, 5 − 75 to 99%, 6 − Every time or 100%
[¥] Nine practitioners did not indicate whether they assess for caries risk

Table 3. Mean percent of adult patients within a practice who receive each caries preventive agent.

Preventive agent	Mean % $^{\Delta}$ (95% CI) $^{\epsilon}$ Percentiles (25, 50, 75) $^{\phi}$
In-office fluoride	51% (46,56) 2, 3, 6
Chlorhexidine rinse	27% (23,30) 2, 2, 3
Non-prescription fluoride	22% (20,24) 1, 1, 3
Xylitol gum	18% (16,21) 1, 1, 3
Prescription fluoride	15% (14,17) 1, 2, 2
Dental sealant	14% (12,16) 1, 2, 2

$^{\Delta}$ Percentage when the ordinal values were transformed as follows to category median: 0%=0%, 1-24%=12.5%, 25-49%=37%, 50-74%=62%, 75-99%=87%, 100%=100%.
$^{\epsilon}$ 95% Confidence interval for Mean %.
$^{\phi}$ 25Th, 50th (median) and 75th percentile for ordinal categories scaled as 1 − Never or 0%, 2 − 1 to 24%, 3 − 25 to 49%, 4 − 50 to 74%, 5 − 75 to 99%, 6 − Every time or 100%

Chlorhexidine rinse. Dentists who had more years since graduation from dental school were less likely to recommend an at-home regimen of chlorhexidine rinse (p=0.016). In step 3, dentists who are more likely to recommend an at-home regimen of chlorhexidine rinse are also more likely to also recommend an OTC fluoride (p<0.001), provide a prescription for some form of fluoride (p=0.015), and recommend sugarless/xylitol gum (p<0.001) to their adult patients. The overall model was a good fit for the data [x^2 (5) = 46.467, p<0.001].

Sugarless or Xylitol gum. In step 3, dentists who more frequently recommend sugarless/xylitol gum are significantly more likely to apply dental sealants (p=0.001) and recommend an at-home regimen of chlorhexidine rinse (p=0.001) to their adult patients. The overall model was a good fit for the data [x^2 (2) = 31.862, p<0.001].

Dentists grouped by preventive profile

Inspection of the agglomeration coefficients from the cluster analysis showed that the percentage increase between the four-cluster and the three-cluster solutions was nearly twice the increase for the preceding steps. This suggests that the final four clusters are sufficiently dissimilar and that the four-cluster solution is the most appropriate[16]. Means and SD for the six caries prevention agents for each of the three-cluster subgroups are presented in Table 5.

Dentists in the largest subgroup (n=99) seldom used any of the preventive agents and we labeled this group as "infrequent users of prevention". Consistent with this, they also had the lowest percentage of patients who receive individual caries prevention (46% of patients) and lowest percentage of patients who desire individual caries prevention (36%). They were also among the subgroups least likely to assess caries risk. This subgroup also contained the lowest percentage of female dentists (51%). These dentists had the lowest percentage of patients 18-44 years of age (34%) and the highest percentage of patients in the 45-64 age group (35%).

Table 4. Modeling to explain the use of preventive agents among adult patients

Preventive agent	Final model fit	B (SE)	P. Value
Dental sealant			
Private practice		0.965 (0.292)	0.001
Dentist gender (female)	x^2 (2) = 9.354, p=0.008*	0.522 (0.250)	0.044
% patients interested in caries prevention	Δx^2 (1) = 3.865, p=0.049**	0.143 (0.706)	0.048
In-office fluoride		0.150 (0.066)	0.042
Sugarless/xylitol gum	Δx^2 (2) = 8.426, p=0.013***	0.219 (0.084)	0.012
In-office fluoride			
Private practice		-0.251 (0.134)	0.056
Dentist gender (female)		0.606 (0.246)	0.014
Patients 65 years of age or older	x^2 (3) = 8.187, p=0.039*	0.027 (0.012)	0.042
% patients interested in caries prevention	Δx^2 (1) = 6.578, p=0.011**	0.255 (0.116)	0.009
Dental sealants		0.347 (0.127)	0.006
Non-prescription fluoride	Δx^2 (2) = 12.207, p=0.003***	0.268 (0.103)	0.001
Non-prescription fluoride			
Dentist gender (female)		0.571 (0.207)	0.009
Patients 65 years of age or older		0.019 (0.011)	0.070
Type of dental school (private)	x^2 (3) = 13.354, p=0.004*	0.631 (0.264)	0.017
% patients interested in caries prevention	Δx^2 (1) = 5.354, p=0.014**	0.212 (0.101)	0.012
In-office fluoride		4.592 (1.179)	< 0.001
Chlorhexidine rinse	Δx^2 (2) = 18.810, p<0.011***	6.572 (1.964)	< 0.001
Prescription fluoride			
In-office fluoride		0.99 (0.043)	0.042
Chlorhexidine rinse	x^2 (2) = 9.484, p=0.009**	0.144 (0.068)	0.012
Chlorhexidine rinse			
Years since dental school graduation		-0.016 (0.007)	0.016
Type of dental school (private)	Δx^2 (2) = 10.431, p=0.005*	-0.338 (0.197)	0.066
Non-prescription fluoride		0.187 (0.046)	<0.001
Prescription fluoride		0.158 (0.065)	0.015
Sugarless/xylitol gum	Δx^2 (3) = 36.036, p<0.001***	0.157 (0.044)	<0.001
Sugarless/xylitol gum			
Dental sealants		0.262 (0.089)	0.001
Chlorhexidine rinse	x^2 (2) = 31.862, p<0.001****	0.291 (0.097)	0.001

* Chi-square (x^2) for model with practice/practitioner variables
** Δx^2 for model with step 2 variables (caries-related practice patterns) added
*** Δx^2 for model with step 3 variables (other preventive agents) added
**** Δx^2 for model with only step 3 variables (other preventive agents) as no variables were significant in the baseline model or following step 2.

The second largest group (n=38 dentists) consistently applied in-office fluoride (91%) and made frequent recommendations for an OTC fluoride rinse (76%). They were also the group most likely to provide a prescription for Chlorhexidine rinse (42%). Overall, they consistently used the full range of preventive agents and we have labeled this subgroup "comprehensive use of prevention". However, they were among the sub-groups least likely to assess caries risk (27%). This subgroup contained the highest percentage of female dentists (74%).

Table 5. Use of preventive agents for adult patients by preventive subgroups and dentist's, patient's, and practice's characteristics

Use of preventive agent	Infrequent users of prevention	Comprehensive use of prevention	In-office fluoride preference	In-office sealant and fluoride
Caries prevention (n=197)	n=99	n=38	n=38	n=22
Dental sealant	4%[Δ] (4, 6)[€a] 1, 1, 2[φ]	24% (19,30)[b] 1, 1, 4	7% (5,9)[a] 1, 1, 2	51% (44,59)[c] 2, 4, 5
In-office fluoride	20% (18,22)[a] 2, 2, 3	91% (88,94)[b] 5, 5, 6	97% (96,98)[b] 6, 6, 6;	48% (41,56)[c] 2, 3, 5
Non-prescription fluoride	12% (10,14)[a] 1, 1, 2	76% (72, 81)[b] 4, 5, 6	3% (0,6)[a] 1, 1, 1	7% (4,11)[a] 1, 1, 2
Prescription fluoride	9% (8,11)[a] 1, 1, 2	24% (19,29)[b] 1, 2, 3	10% (7,12)[a] 1, 1, 2	33% (26,41)[c] 1, 2, 4
Chlorhexidine rinse	23% (21,25)[a] 2, 2, 3	42% (37,48)[b] 2, 3, 4	27% (23,31)[a] 2, 2, 3	22% (18,26)[a] 1, 2, 3
Sugarless/xylitol gum	14% (11,18) 1, 1, 2	21% (14,27) 1, 1, 3	21% (14,27) 1, 1, 2	17% (9,25) 1, 1, 2
Practice characteristics				
Dentist gender (females)	51%[a]	74%[b]	60%	59%
Type of practice (private)	52%	47%	38%[a]	75%[b]
Years since dental school graduation	19.9 (SD=12)	18.5 (SD=9)	19.7 (SD=11)	20.3 (SD=11)
Type of dental school from which the dentist graduated (public institution)	79%	68%	87%	76%
Specialization (specialization training)	60%	68%	68%	60%
Advanced degree (Master's or doctorate)	31%	24%	30%	40%
Percent of patients by age cohort				
Pediatric patients	18%	16%	24%	20%
Adults (19-44 years)	34%[a]	35%	38%	45%[b]
Adults (45-64 years)	35%[a]	34%	25%[b]	25%[b]
Adults (65 years and older)	13%	15%	13%	9%
Assess caries risk for individual patients	29%[a]	27%[a]	47%[b]	42%[b]
Patients who desire individual caries prevention (%)	36%[b] 2, 3, 4	51%[a] 3, 4, 4	53%[a] 3, 3, 4	49%[a] 3, 4, 4
Patients who receive individual caries prevention (%)	46%[a] 2, 3, 5	55% 2, 4, 5;	68%[b] 3, 5, 6	60% 3, 4, 5

Groups with different superscripts are different using a Bonferroni correction (p=0.01) for that variable and groups without superscripts or that share superscripts are not significantly different. Subgroups did not differ on other practice characteristics.
[Δ] Percentage when the ordinal values were transformed as follows to category median: 0%=0%, 1-24%=12.5%, 25-49%=37%, 50-74%=62%, 75-99%=87%, 100%=100%.
[€] 95% Confidence interval for Mean %.
[φ] 25th, 50th (median) and 75th percentile for ordinal categories scaled as 1 – Never or 0%, 2 – 1 to 24%, 3 – 25 to 49%, 4 – 50 to 74%, 5 – 75 to 99%, 6 – Every time or 100%

The next group also consisted of 38 dentists; these dentists tend to focus on the use of in-office fluoride (97%) and seldom recommend at-home use of prescription or OTC fluoride. This group was labeled "in-office fluoride preference". Along with the "in-office sealant and fluoride preference" subgroup discussed below, they were the most likely to assess caries (47%). In addition, they had the highest percentage of patients who desired (53%) and received (68%) individual caries prevention.

The final group was the smallest (n=22) and had the most frequent use of dental sealants (51%) and in-office fluoride (47%). They were also the ones most likely to recommend fluoride prescription. This group was labeled "in-office sealant and fluoride preference" and had the higher percentage of practitioners using a private practice model. Along with the "in-office fluoride preference" subgroup discussed above, they were the most likely to assess caries risk in their patients (42%).

DISCUSSION

To our knowledge this current work is the first report in the literature about caries prevention in adults by Brazilian dentists as assessed using the translated version of the "Assessment of Caries Diagnosis and Caries Treatment" Questionnaire from the Practice-Based Research Network in the United States of America.

Dentists participating in this study were primarily middle-aged (42.2 years) females (59%), working in a private hybrid (private + public) model (78%), graduated from a public institution (77%), and had received specialty training (63%). Demographic data from the Regional Council of Dentistry of São Paulo State showed that 57% of dentists from Araraquara were female and 66% were younger than 50 years of age[17]. National data show that most Brazilian dentists are female (51.2%), are up to 40 years-old (57.4%), graduated from private schools (65.0%) and had no specialty training (75%)[18]. Therefore, in spite of using a convenience sample, demographic data from participant dentists were quite similar to dentists from Araraquara and a lesser extent to Brazilian dentists.

Dentists in the current study reported that in-office fluoride application was the preventive method most commonly used (51% of patients) for caries prevention in adults. Participating dentists also reported recommending non-prescription fluoride to 22% of their adult patients (Table 3). Dentists from Japanese[9] and US[8] dental PBRNs recommended in-office fluoride application to 21% and 37% of their adult patients, respectively. Brazilian dentists reported recommending in-office fluoride at more than twice the rate of Japanese dentists. Yokoyama et al.[9] (2016) mentioned that the focus of the current Japanese health insurance system is disease treatment and that it does not cover most preventive dental care services. As a result, the percentage of Japanese dentists providing preventive treatment may be reduced[9]. Brazilian oral health insurance system and public service offer several preventive measures, including in-office fluoride application. Taking into account that 98% of dentists in the current study reported working in a private and/or public health service, and that participant dentists believe that 44% of their adult patients are interested in a caries prevention regimen, their first choice for caries prevention dentists was in-office fluoride application, which was significantly higher than those reported by dentists from the Japanese and US dental PBRNs.

Chlorhexidine rinse was also reported frequently by Brazilian dentists as a caries preventive agent for their adult patients (Table 3). Scientific evidence for chlorhexidine as a caries preventive agent is not consensual. Some authors found statistically significant differences in Streptococcus mutans levels during and after the use of a chlorhexidine mouthwash on patients with moderate to high caries risk. However, they suggested the need for additional studies in order to assess whether the results con-

firm the reduction in dental caries and, consequently, whether or not these products should be incorporated into existing prevention protocols[19]. Others studies have not found good evidence of the effectiveness of chlorhexidine for caries prevention[20,21].

Results from our regression analyses suggest that the main predictor for recommending in-office fluoride application or other preventive methods was dentist gender, with females recommending more often than male dentists (Table 4). These findings are in agreement with those of Riley et al.[22] (2011), who found that female dentists had a greater overall preventive orientation than male dentists for both adult and pediatric patients. However, the scientific literature is not consensual about gender differences on attitudes on prevention and treatment of dental caries. Some researchers have found a more-conservative approach towards prevention and treatment of dental caries among female dentists[23-26]. In contrast, other studies have found no statistically significant relationship between dentist gender and choices for caries prevention or treatment[27-29]. A previous Brazilian study has also found no association between dentists' gender and decision making for restoring dental caries as seen in radiographs[30]. Further studies are needed to clarify this issue.

Other predictors for recommending some type of preventive method showed that patients 65 years of age or older are more likely to receive in-office fluoride (Table 4). This finding could be related to dentists being concerned with the prevention of root caries. Root caries is most commonly found in the elderly population, with four out of ten adults being affected[31]. Brazilian elderly presented a mean DMFT of 27.5, with a mean of 0.2 decayed roots and 0.1 filled roots[1]. The overall prevalence of root caries was estimated at 41.5% in a systematic review and meta-analysis published by Pentapati et al.[31] (2019). The authors related that the number of adults with root caries might expand in the future because of the increase in aging population and dentition longevity, and suggested that preventive measures should be the focus of policy-makers and health care professionals to reduce the burden of disease among the elderly.

It is relevant to emphasize that the percentage of patients interested in caries prevention may be predictive of dentists being more likely to provide dental sealants, in-office fluoride application or non-prescription fluoride to their adult patients. Although there is lack of literature supporting the cost-effectiveness of use of fluorides and sealants for caries prevention in adult patients[32], one can speculate that patient interest in caries prevention may stimulate dentists to adopt a more-preventive approach, perhaps influenced more strongly by the patients' interest than by the patients´ caries risk. In the current study only 34% of dentists assessed caries risk for individual patients (Table 1). Another possible explanation is that dentists are working in a person-centered care environment, employing the principles of shared decision-making[33] in which the patient can act as a partner who co-designs his/her care delivery[34]. Further studies are needed to assess these assumptions.

Modern caries management emphasizes a conservative and preventive evidence-based philosophy, with personalized disease management, monitoring of caries lesions, and efforts to remineralize and/or arrest lesions[32]. As we consider the above-mentioned evidence in caries prevention, it is worth discussing the results of cluster analysis that showed a clear agglomeration of dentists in the largest subgroup (n=99) characterized by infrequent use of prevention and associated with the

following profile: 1) lowest percentage of patients who receive or desire individual caries prevention, 2) least likely to assess caries risk, 3) lowest percentage of female dentists, and 4) the highest percentage of patients in the 45-64 age group (Table 5). The results of the current study showed a gap between evidence-based dentistry and dental practice for half of participating dentists. Although there are limitations associated with the study, it clearly indicates that additional means to translate current evidence-based findings for caries prevention into clinical practice is needed and it may be targeted to the above-mentioned practice characteristics.

This study did have these limitations: a) we cannot infer causality from a cross-sectional design; b) it used a convenience sample and singular characteristics of the region (access to a dental school, preventive practices taught in the region, etc.) may have strongly influenced the results; c) the assumption that the reported overall preventive measures are actually what the responding dentists perform routinely and not related to individual patient recommendations for single or multiple treatments[22]; and that they may be influenced by social desirability and recall bias[8]. The study strengths include the similarity of the demographic characteristics between the participating dentists and those from Araraquara, and the feasibility of the questionnaire to assess and to compare dental practice patterns among dentist populations[35].

In conclusion, in-office fluoride application was the most commonly reported preventive method for caries prevention in adults. Some practitioner, practice and patients' characteristics were positively associated with more-frequent use of a preventive agent.

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