Routine Dental Visits Are Associated with Tooth Retention in Brazilian Adults: the Pró-Saúde Study

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Abstract

Objective: *This study investigates the effect of routine visits for dental check-up on tooth loss.* ***Methods:*** *In a cross-sectional study of university employees, the Rio de Janeiro Pró-Saúde Study, tooth loss was measured as the reported number of missing teeth and routine dental visit as the reported pattern and frequency of visits to the dentist.* ***Results:*** *Data were obtained from 4,030 individuals (91% of eligible subjects). Odds ratio of excessive tooth loss ("many" or "all" teeth lost) was 2.20 (95% confidence interval [CI]=1.79, 2.72) for subjects who reported visiting the dentist only when in trouble and 1.17 (95% CI=0.90, 1.51) for subjects who reported visiting for routine dental checks every two years or less frequently, compared with those who reported visiting for dental checks at least annually, after controlling for age, sex, education, income, race, smoking, and diet.* ***Conclusions:*** *There was a positive effect of routine visits for dental check-up on maintaining teeth. This effect was the same for one year and two years or longer intervals between check-ups. [J Public Health Dent 2004; 64(4):216-22]*

Key Words: oral health, dental health services, dental check-up, preventive health services, tooth loss, logistic models, regression analysis, Brazil.

A frequent underlying assumption is that routine dental checks are beneficial for oral health. This assumption is the basis for advising the public to visit the dentist regularly at intervals of 6 or 12 months to obtain early diagnosis, prevention, and treatment of oral diseases (1,2). However, there is little justification for the six-monthly visits to the dentist (3). There is some evidence, specifically in children and in older adults, that the interval between routine dental checks could be longer than one year (4-6). Longer intervals were not associated with increase in the severity of oral diseases or the need for more complex dental treatment. On the contrary, longer intervals were associated with less treatment provided and lower costs (7-10).

Epidemiologic data regarding the effect of dental checks on dental health are limited and no clinical trial data are available. Ideally, evidence regarding this question should be obtained from large, simple, randomized trials (11). In the absence of such trials, observational epidemiologic investigations may provide useful information. Most longitudinal studies of the effect of different dental visiting patterns on tooth loss did not find a significant association (6,12-17) and for those that did find an association, the differences in the number of teeth lost were small, varying from 0.7 to 2.6 fewer teeth missing in "regular" users than in "irregular" users (9,18-20).

Most studies used as oral health outcome measure the DMFT (decayed, missing, and filled teeth) or several indicators of periodontal diseases, such as pocket depth and attachment level (6,21,22). The loss of teeth is considered a true endpoint of oral disease (23), as it is related not only to clinical and anatomical aspects, but also to functional and psychosocial aspects clearly important for people's well-being (24,25).

The idea underlying our study is that routine dental visits should alter the natural history of dental diseases for the better, eventually leading to greater tooth retention. Considering the general improvement in oral health observed over the last decades and the relatively slow rate of progression of the major dental diseases, maybe people could be advised to visit the dentist less often than the current recommendation of annual visits (20,26). Therefore, the aim of this study was to assess the relationship between dental visits for dental check-up and tooth loss, comparing individuals who reported visiting the dentist for routine dental checks at least yearly with those who reported visiting for routine dental checks at intervals of two years or longer and with those not visiting for dental checks, doing so only when in trouble.

Methods

The city of Rio de Janeiro has a population-to-dentist ratio of 676 people per dentist and there are a large number of dental clinics both in the state and in the private oral health care sectors. In Brazil, dental care in the state sector is free of charge and offers limited services, predominantly clinical exams, tooth extractions, and fillings. These procedures take up 90 percent of the state oral health resources (27). The private system is financed by direct payment to the dentists and by private dental insurance. Seventy percent of the available professional time and resources are spent in the private sector, where the population is offered unlimited services within the whole range of the modern dental specialties, including endodontics, periodontics, orthodontics, prosthetics, and implants (27). Generally, the private oral

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TABLE 1
Description of University Employees in Four Routine Dental Visiting Groups: the Pró-Saúde Study, 1999

	Dental Visits			Total*		
	Routine Check-up at Least Once per Year (*n*=1,715)	Routine Check-up Every 2 Years/Less Frequently (*n*=876)	Only When in Trouble (*n*=1,343)	Never (*n*=50)	All (*n*=3,984)	*P*-value
% excessive tooth loss†‡	20.26	19.89	40.27	57.14	27.38	<.001
Demographic characteristics						
Mean age (SD)	40 (8.37)	38 (8.32)	41 (9.11)	47 (10.71)	40 (8.80)	<.001
% female	64.14	53.31	46.98	24.00	55.47	<.001
Income¶						
% first quintile (<$174 USD)	15.20	12.50	29.23	67.57	19.95	
% second quintile	16.81	20.19	24.01	21.62	20.04	
% third quintile	20.52	21.88	18.48	5.41	19.98	
% fourth quintile	21.51	23.20	16.59	5.41	20.06	
% fifth quintile (>$622 USD)	25.96	22.24	11.69	—	20.06	
Education						<.001
% less than primary	3.70	4.13	11.51	34.04	6.79	
% primary	13.69	10.56	23.33	48.94	16.66	
% secondary	33.84	38.00	38.00	10.64	35.88	
% university	48.77	47.30	27.16	6.38	40.67	
Race						<.001
% white	58.17	56.03	43.63	29.79	52.48	
% mulatto	24.25	29.74	34.98	48.94	29.36	
% black	15.28	11.60	18.59	17.02	15.59	
% other	2.30	2.64	2.81	4.26	2.57	
Life-style characteristics						
% smoking§	40.57	36.19	47.51	68.09	42.28	<.001
% diet•	28.50	14.91	15.40	23.91	21.04	<.001

*Of the 4,030 participants, 3,984 answered the question about routine dental check-up.
†Excessive tooth loss=many and almost all or all teeth missing.
‡When comparing excessive tooth loss between routine dental check-up at least once per year with every 2 years or less frequently, the difference was not statistically significant (*P*=.82).
¶Income=per capita net monthly income.
§Smoking=at least 100 cigarettes during entire life.
•Diet=eating fruits and vegetables at least once a day.

health care services are used by those with higher income and the state services by those with lower income. Fluoride is widely used through water fluoridation and fluoride dentifrices; water fluoridation covers more than 82 percent of the population and 99 percent of the marketed dentifrices contain fluoride (28).

Design and Study Population. Data for the study were obtained from the Pró-Saúde Study, a cohort study of university employees in Rio de Janeiro, Brazil, which investigates social determinants of health behaviors and diseases (29). We obtained cross-sectional data from the baseline assessment undertaken in 1999. The target population comprised all technical and administrative staff of the university, except those already retired or in license at the time of data collection. Our study population has higher income and better access to health care than the population of the city of Rio de Janeiro in general; 56.6 percent had private health care insurance.

Self-administered questionnaires, containing pre-coded questions, were completed by the participants in the work place. Written informed consent was obtained from all participants. Methods to ensure the quality of the information were applied, including a large pilot study, test-retest, and double data entry. Ethical approval was obtained from the Ethical Committee of the University of the State of Rio de Janeiro.

Outcome and Exposure Definitions. The dental condition assessed was tooth loss. The outcome variable was excessive tooth loss. Participants were asked the following: "During the lifetime, many people lose some or even all teeth. Which of the options below best represents the number of teeth you lost?" 1="I lost no teeth"; 2="I lost one or a few teeth"; 3="I lost many teeth"; 4="I lost almost all or all of my teeth." Categories "missing all or almost all teeth" and "missing many teeth" were joined into one group (excessive tooth loss) and categories "none" and "missing one or a few teeth" were joined in another group (natural functional dentition). The choice of having a dichotomous outcome variable, and this cut-off point, was due to the fact that those

TABLE 2
Distribution of Tooth Loss, According to Dental Visits, Demographic and Life-style Characteristics of University Employees: the Pró-Saúde Study, 1999

		Excessive Tooth Loss*†		
	n	No (*n*=2,891)	Yes (*n*=1,111)	*P*-value
Dental visits				<.001
% routine dental check-up at least once per year	1,703	47.17	31.79	
% routine check-up every 2 years or less frequently	876	24.38	16.05	
% only when in trouble	1,336	27.72	49.57	
% never	49	0.73	2.58	
Demographic characteristics				
Mean age (SD)	4,002	38 (7.64)	47 (8.25)	<.001
Sex				.85
% female	2,224	55.48	55.80	
% male	1,778	44.52	44.20	
Income‡				<.001
% first quintile (<$174 USD)	749	15.08	33.07	
% second quintile	754	17.87	25.92	
% third quintile	753	21.06	17.08	
% fourth quintile	756	22.47	13.51	
% fifth quintile (>$622 USD)	754	23.52	10.43	
Education				<.001
% less than primary	273	2.82	17.50	
% primary	661	12.16	28.44	
% secondary	1,421	36.06	35.18	
% university	1,612	48.95	18.87	
Race				<.001
% white	2,072	57.92	38.17	
% mulatto	1,157	26.69	36.14	
% black	619	12.73	23.40	
% other	101	2.66	2.29	
Life-style characteristics				
Smoking¶				<.001
% yes	1,616	36.09	58.14	
% no	2,224	63.91	41.86	
Diet§				.15
% yes	834	20.42	22.48	
% no	3,139	79.58	77.52	

*Of the 4,030 participants, 3,984 answered the question about routine dental check-up.
†Excessive tooth loss=many and almost all or all teeth missing.
‡Income=per capita net monthly income.
¶Smoking=at least 100 cigarettes during entire life.
§Diet=eating fruits and vegetables at least once a day.

who reported one or a few missing teeth probably had at least 20 teeth (30) and this was considered an acceptable functional natural dentition (25,31,32). In addition, statistical tests with various groups revealed that the best model fit was obtained when the number of teeth lost was dichotomized.

The main exposure was the reported dental visiting pattern for routine check-up. Participants were asked: "In general, how frequently do you go to the dentist for a routine dental check?" Responses categories were: 1="I have never been to the dentist"; 2="I don't usually go for a routine dental check, I only go to the dentist when I have a problem"; 3="Less frequently than once every two years"; 4="Once every two years"; 5="At least once per year." For these analyses, options 3 and 4 were joined into one category, since results were the same when these options were analyzed separately. Potential confounding variables of the association between dental visits for check-up and tooth loss were age, sex, race, education, income, smoking, and diet. Race, education, and income were classified according to the Brazilian Census (33). Income was categorized using cut-off points based on the quintiles of the per capita net monthly income, i.e., total family monthly income divided by the

TABLE 3
Odds Ratios (OR) and 95% Confidence Intervals (CI) of Association Between Excessive Tooth Loss and Dental Visits Adjusted for Age, Sex, Income, Education, Race, Smoking, and Diet Among University Employees: the Pró-Saúde Study, 1999

	Adjusted OR*	95% CI	*P*-value
Dental visits†			
Routine check-up at least once per year	1.00		
Routine check-up every 2 years or less	1.17	(0.90, 1.51)	.24
Only when in trouble	2.20	(1.79, 2.72)	.00
Never	1.53	(0.64, 3.69)	.34
Demographics characteristics			
Age	‡		.00
Female sex	1.22	(1.01, 1.47)	.04
Income¶			
First quintile	1.81	(1.29, 2.54)	.00
Second quintile	1.92	(1.39, 2.65)	.00
Third quintile	1.36	(0.98, 1.87)	.07
Fourth quintile	1.22	(0.88, 1.70)	.22
Fifth quintile	1.00		
Education			
Less than primary	2.81	(1.86, 4.24)	.00
Primary	1.82	(1.35, 2.44)	.00
Secondary	1.77	(1.40, 2.25)	.00
University	1.00		
Race			
White			
Mulatto	1.36	(1.10, 1.69)	.01
Black	1.63	(1.26, 2.10)	.00
Other	0.72	(0.40, 1.32)	.29
Life-style characteristics			
Smoking§	1.62	(1.35, 1.96)	.00
Diet•	0.81	(0.64, 1.01)	.06

*Percent correctly classified=79.81%.
†Of the 4,030 participants, 3,541 answered all the questions.
‡Age+Age^2.
¶Income=per capita net monthly income.
§Smoking=at least 100 cigarettes during entire life.
•Diet=eating fruits and vegetables at least once per day.

number of persons in the family. Smoking at least 100 cigarettes during the whole life was considered not only a risk factor for tooth loss, but also a marker of overall negative life-style characteristics (12). Eating fruit and vegetables at least once per day was considered a positive life-style characteristic (34).

Data Analysis. Individuals in the four dental visit groups were described according to the outcome and covariates. Differences were tested using ANOVA and chi-square and Fischer exact tests. Logistic regression was carried out to examine the strength of the associations between dental visit and tooth loss, controlling for potentially confounding variables. Multiplicative interactions between dental visits and covariates were tested in the logistic regression models. Model goodness of fit was assessed by deviance, model statistics, residual, and outlier analyses (35). Individuals who did not answer all the questions were excluded from the logistic regression analysis (n=489). The "number needed to treat," or NNT, was estimated (36). All statistical tests were carried out at the .05 level of significance. STATA statistical software was used for data analysis (37).

Reliability was assessed for the main variables in a test–retest study, with a two-week interval between responses, using a convenience sample of 192 employees. Quadratic weighted kappa was used (38).

Results

Of the 4,614 staff of the university, 166 (3.6%) were not eligible for the study. The study population included 4,030 employees, representing 91 percent of the eligible population (4,448); 418 (9,4%) did not participate for several reasons (some refused and others were not found).

Differences in Demographics and Life-style Characteristics. Dental visit habits were significantly associated not only with tooth loss, but also with demographic and life-style characteristics (Table 1). When compared with individuals who reported not visiting for dental checks and doing so only when in trouble, individuals who visited the dentist for routine dental checks at least once per year were significantly more likely to be younger, female, richer, more educated, white, nonsmokers, and to eat fruits and vegetables at least once per day.

Association Between Dental Visits and Tooth Loss. Of the individuals who visited the dentist only when in trouble, 40.3 percent had lost their natural functional dentition. Among those who visited the dentist for a routine dental check-up, 20.3 percent and 19.9 percent (at least once per year and every two years or less frequently, respectively) lost their natural functional dentition, and the differences between these two latest groups were not statistically significant (chi-square test, P>.05) (Table 1).

Tooth loss was significantly associated with all other variables except sex and diet (Table 2). When compared with those who did not have excessive tooth loss, individuals who lost their natural functional dentition were significantly more likely to be older, poorer, less educated, black, or mulatto, and to smoke (P<.05).

Unadjusted for any confounding variables, individuals who did not visit the dentist for routine check-up, visiting only when in trouble, were nearly three times more likely to experience excessive tooth loss than those who visited the dentist at least once per year for a routine check-up (odds

ratio [OR]=2.73, 95% confidence interval [CI]=2.30, 3.25). After controlling for demographic and life-style characteristics, the odds ratio reduced to 2.20 (95% CI=1.79, 2.72) (Table 3).

The chances of keeping a natural functional dentition were the same for individuals who had routine dental checks at least once per year or every two years or less frequently (Table 3).

Individuals excluded from the logistic regression analysis (11%) had more excessive tooth loss and less favorable demographic and life-style characteristics than those included. Multiplicative interactions between dental visit and covariates were not found. Goodness of fit tests and residual analysis indicated model adequacy with 79.81 percent of the individuals correctly classified. Outliers were not detected.

The NNT was 5 (95% CI=4.97, 5.03); it was necessary that five people, in general, visited for routine dental check-up to avoid one more person losing the natural functional dentition compared to people who visited only when in trouble.

Reliability. The test-retest reliability of tooth loss was 0.75 (95% CI=0.64, 0.87) and of routine visits for dental check-up was 0.71 (95% CI=0.60, 0.80) (Table 4). Covariates also had acceptable kappa scores, ranging from 0.69 to 1.

TABLE 4
Reliability of Tooth Loss and Dental Visits Among a Sample of University Employees: the Pró-Saúde Study, 1999

	Percent Agreement	Quadratic Weighted Kappa (95% CI)
Tooth loss	91.62	(0.64, 0.87)
Dental visits	75.66	(0.60, 0.80)

Discussion

It can reasonably be assumed that at "baseline," i.e., when the individuals were approximately between 6 and 12 years of age, 28 permanent teeth soundly erupted into their mouths (39). At the moment of data collection, when the average age of the participants was 40 years, i.e., after an average of 25 years, the individuals differed significantly in their dental status.

Our main finding was very similar to one reported in the Adult Dental Health Survey of the United Kingdom in 1988, where 42 percent of the individuals who visited the dentist only when in trouble lost their natural functional dentition, compared to 21 percent of those who visited on a regular basis (40).

In our study, individuals who reported one or a few missing teeth probably had at least 20 teeth, since in a validation study elsewhere, with 6,185 participants, regression analysis indicated well-discriminating and precise assessments of the actual number of teeth relating to each of the five reported categories, where the categories were related to the following number of remaining teeth: "lost no teeth"—27 teeth; "lost one or a few teeth"—25 teeth; "lost rather many teeth"—20 teeth; "lost almost all of the teeth"—8 teeth; "lost all teeth"—0 teeth (30). Ideally, people should keep a complete natural dentition, with no missing teeth. However, a natural dentition with at least 20 remaining teeth, without prosthetic replacement, is acceptable, as it is compatible with good oral function, based on objective and subjective assessments (25,31, 32,41). This was the rationale to define "excessive tooth loss" and "natural functional dentition" in the present study.

The benefit of the check-up visit can be better interpreted with the "Numbers Needed to Treat" or NNT (36). The NNT was 5 (95% CI=4.97, 5.03). Such a small NNT suggests that routine dental checks, either at least annually or at two-year intervals, were very beneficial. On the other hand, it suggests that for five people who visited the dentist for a routine dental check, four did not improve the chance of keeping a natural functional dentition.

The large sample size of the Pró-Saúde Study provided the opportunity to detect moderate-to-small treatment effects not immediately apparent in most other studies. Despite differences in the losses of individuals between the groups, the relatively low number of losses overall (11%) minimized the potential for bias in this study.

The use of self-reported dental visiting data might have brought inaccuracy into the results. However, validation studies indicated that the reported dental visiting frequency was overestimated only by 10 percent (42-45) and our reliability study found acceptable kappa scores.

Although we did not carry out a clinical examination to validate the self-reported number of teeth, in addition to the validation study reported earlier (30), several studies revealed that self-reported data on number of missing teeth were not remarkably different from those obtained at clinical examination (40,46-50). If the reliability of this question in our study had been poor or if the expected associations between tooth loss, life circumstances, and life-style characteristics had not been found, we would be less confident about the validity of the self-reported number of teeth. Forty-two participants reported having lost several teeth and never visiting the dentist, maybe extensive decayed teeth with only the root remaining were reported as missing by the participants.

The main limitation of this study was the cross-sectional design, which did not allow a solid conclusion about the causal relationship. It could be argued that people with higher incidence of dental disease would, because of that, visit the dentist more often. In this case, the dental condition would come first and determine dental visiting habits. In our analysis, we assumed that the dental visiting habits for routine check-up were established first and/or independently of the dental condition, and determined the numbers of teeth lost throughout the years.

Our and other external evidence showed that less educated and poorer individuals experienced higher incidence of dental disease and tooth loss, but tended to visit the dentist only when in trouble and not for routine dental check-ups. On the other hand, more educated and richer individuals experienced lower incidence of dental disease and tooth loss, but visited the dentist more often and for routine dental check-ups (51-57). If the incidence

of dental problems was a significant determinant of dental visiting habits, people with a higher risk of having dental problems should have visited the dentist more often than did people with a lower risk of having dental problems. The opposite was true.

The main aim of dental care is to help maintain a natural functional dentition for life, including all social and biological functions such as self-esteem, esthetics, speech, chewing, taste, and comfort (24,32,58). It appears that the dental check-up visits, either at shorter or longer intervals, helped many individuals in this study to keep a natural functional dentition. Increasing the intervals between dental check-up visits allows dental services to provide dental care to more people and reduces unnecessary medicalization (59). However, before final conclusions could be drawn about the benefit of the dental check-up visits, and the most appropriate intervals between them, longitudinal studies, preferably controlled clinical trials, should be carried out. In addition, other important outcomes should be assessed, including dental pain and sociopsychological indicators of oral well-being. Meanwhile, to keep a functional natural dentition, people could be advised to visit the dentist for a check-up once every two years or even less often.

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